Subterranea

The Magazine for Subterranea Britannica

Subterranea Britannica **April 2021 Issue 56**

IN THIS ISSUE

London's Lost Cold War Controls
Ace High Dishes - Stenigot
Tura Caves - Egypt
Corsham Telephone Exchange

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life.
Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.
Contributors to *Subterranea* also give their permission for articles and images to be reproduced on Sub Brit's website.

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Contents

Chairman's Welcome ____ 1
Dates for Your Diary ____ 2
The Sub Brit Forum ____ 3
Autumn Day Meeting and Visits Day ____ 4

News

Archaeology ____ 5
Conservation and Heritage ____ 5
Health & Safety ____ 6
Military and Defence ____ 7
Miscellaneous ____ 12
Mines and Mining ____ 14
Publications and Book Reviews ____ 16
Tunnels & Tunnelling ____ 20

Features

London's Lost Cold War Controls ____ 24
To trash or treasure: the cautionary case of the Ace High Dishes ____ 35
Dolomite, Ironstone and Non-Ferrous Mines in Luxembourg ____ 39
Tura Caves - Egypt's source of Limestone ____ 40
Dunham-on-the-Hill - an unusual Royal Ordnance Factory 50
Memories of Vange Anti-Aircraft Operations Room 58
Tunnelling through the Rockies ____ 60
The Japanese WWII tunnel complex in Western Sumatra ____ 61
Char-Coal Mining ____ 63
Corsham Telephone Exchange ____ 64
Buckden ROC Posts - Listed at last ____ 68
Icehouse Reflections: Thirty Years On ____ 70
V2 Rocket Launch site in France ____ 76

Front cover photo: *Equipment rack in the tape relay room in the North West London Control at Southall during a visit by members of Sub Brit in 2013. The rack contains a mixture of relays and valve amplifiers, the latter for voice-frequency circuits. The openings in some case covers would suggest that these give access to presettable controls for adjusting signal gain levels. The second row down is a fuse panel with two rows of fuses. Further down are either valves or neon stabilisers for critical power supplies. Below that a patch panel enabling (perhaps) different teleprinters to be connected to a choice of circuits. Photo Nick Catford*

Back page upper: *A drone view of the four parabolic dish antennas at the Ace High tropospheric scatter radio station at Stenigot, Lincolnshire in July 2018, three months before demolition of two of them. In 1959, Stenigot was selected as part of NATO's Ace High communications programme developed in the mid-1950s. Ace High was a tropospheric scatter/microwave link system providing an exclusive communications network comprising 49 tropospheric scatter links and 40 line-of-sight microwave links. It extended from northern Norway and through central Europe to eastern Turkey. The Ace High network was abandoned in the early 1990s and the stations closed. The equipment and buildings were removed in 1996 although the four parabolic dishes were left lying on the ground. Photo NW Scrappy*

Back page lower: *The Woodlands telephone exchange in the Central Government Emergency War Headquarters during an official Sub Brit visit in 2013. In about 2010 the air conditioning was switched off and decay very quickly set in as seen here. In 2019/20 dedicated dehumidifiers to maintain the environment within the exchange were installed. The operator positions were then painstakingly brushed and vacuum cleaned and conservation-grade wax was applied to the consoles. Photo Richard Seabrook*

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The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Tim Wellburn

Welcome to *Subterranea* 56, our first edition of 2021 and, with a bit of luck, the last to be published under Covid restrictions. Once again, the magazine ranges over a diverse collection of underground topics, and is likely to add yet more places to our personal '*to visit*' lists.

It was frustrating to have to cancel our hoped-for Spring Meeting, but we are working with determination towards finally seeing each other in three dimensions at Sywell in October for the Autumn Meeting and the associated programme of visits around Northamptonshire. See photos below of two of the sites we hope to visit in October. We plan to make a final assessment and – we very much hope – a 'go-ahead' decision at the June committee meeting. We'll ensure that arrangements are notified in good time. The same goes for any other events that it may be possible to arrange before then.

3076 yard Blisworth Tunnel on the Grand Union Canal. Photo Ade Armishaw

It is not, of course, the sole prerogative of the committee to arrange trips: any member is welcome to take the initiative in doing so, and – as long as it's safe and permitted – we will be more than happy to support you in turning it into an 'official' Sub Brit trip. I do encourage you to think about underground locations, local or known to you, that fellow members would be interested in visiting – and make a trip proposal.

A hearty thankyou to all who attended our 2021 online AGM. By definition, these events are never going to be as much fun (especially for the Chairman) as, for example, exploring subterranean London with Nick Catford, but it was good for Sub Brit to have a solid turn-out. For those who may have missed it on the day, the minutes are in this issue of *Subterranea*.

The basic message was that Sub Brit weathered 2020 in pretty good shape, and certainly emerged with a much stronger public profile. This was very largely thanks to the considerable efforts of a handful of people who made things happen – and continue to do so.

Our social media presence, led by James Buller, now has over 11,700 followers across Twitter, Facebook and Instagram. Their frequent posts raise awareness of interesting sites and of our Society. They often spark conversations and extra tit-bits of information from non-members. December saw particularly high engagement with tweets about #WorldTunnelDay, our webinars and *Subterranea*. Do follow us, share the messages – and tip James off about relevant stories if you can.

Tony Radstone has been heroic in persuading an eclectic group of underground experts to share their knowledge and enthusiasm with us – and with many of our followers and potential members – through Sub Brit's *In The Dark* webinars. By mid-April, we had run 18 of these with a cumulative 'live' audience of around 3,000 people and over 11,000 subsequent viewings on YouTube – another clear demonstration of Sub Brit's significant reach.

Our public website is also seeing incredible activity – in 2020, 75 million 'hits' (an occasion when an item was requested from the website) – a four-fold increase over the last five years. So thankyou to those who continue to add site information to it.

And, not least, our new online, searchable archive of *Subterranea* makes the wealth of content in these superb magazines publicly available – all but for the six latest issues, which remain our preserve as Sub Brit members. So enjoy reading this new one!

chairman@subbrit.org.uk

Mid-England Barrow at Banbury. Photo Ade Armishaw

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events

Sub Brit specific events

2021

20 May "In the Dark" online Webinar: Mines Rescue and Safety Awareness

19 June Committee Meeting, online

1 July Copy deadline for *Subterranea* 57

31 August *Subterranea* 57 published

9 October Committee Meeting, online

16 October Autumn Meeting at Sywell Aerodrome

16 - 17 October Site Visits, Northamptonshire

1 November Copy deadline for *Subterranea* 58

Mid-December *Subterranea* 58 published

2022

12 March Visit to Dumpy Level, Dover Castle – Trip 1

For web links to these events please visit *www.subbrit.org.uk/events*

If you know of other relevant events run by other societies, please let us know so that they can be advertised in the next edition and on the website

A reminder of pre-Covid times when mass gatherings were allowed. Hopefully we will be able to resume members' site visits later in 2021. This is the 2009 Kent weekend when we visited Golgotha Tunnel on the East Kent Light Railway. Photo Jane MacGregor

The Sub Brit Forum

-or- How to keep up to date with events and news

If you are not using the Sub Brit Forum you will be missing out on news about events and on general information and discussion on underground matters. But did you know that you can still get any category of Forum posts **emailed** to you? To get this set up you will need to log on to the Forum at least once (see below). Once you are set up you can even reply by email to topics and automatically update the Forum. Here are some hints to help you:

First, Log on to the Forum (see below). Have a look round the Forum to see what's there.

* You can browse **Categories** (eg 'Cold War', 'Transport') by clicking on 'Categories' in the middle of the top line (or in the box, top left, for a fuller display).
* You can search for **Topics** (eg 'Tube Map') by using the 'Magnifying Glass' symbol near the top right-hand corner.
* To get back to the Forum Home Page, click 'Subterranea Britannica' on the black banner.

To get **emails** (notifications) about material posted to the Forum:

* click on the big bold letter (this will be the first letter of your username) or your photo, (if you've set one up) in the top right-hand corner
* select the little man symbol, and then click 'Preferences'
* then 'Categories', under 'Notifications' down the left-hand side
* Select the categories you want to be notified about using the boxes on the screen.
* You can also stop emails ('mute') about a topic or category here.

Another way to get email notifications, once you know the Categories you look at most:

1. Navigate to 'Categories' from the main Forum page.
2. Click the Category of interest.
3. In the top right-hand corner, click the button marked with a 'Bell' next to 'New Topic' and select the type of notification you want. You will then get emails for every post here.
4. You can change your preferences at any time.

And if you don't want anything emailed to you – then we suggest you just browse the Forum!

How to log on to the Forum – reminder

* Go to https://community.subbrit.org.uk/
* Log in using your membership username and password.

If you've forgotten them use 'Activate my account / Reset my password'.

Autumn Day Meeting Saturday 16 October 2021

10.00am, Cirrus room, Aviator Hotel, Sywell Aerodrome, Northamptonshire

The day will take the usual format, with refreshments on arrival, before the meeting starts. There are four diverse speakers arranged:

- Jo Emery will be taking us behind the scenes at Drakelow WWII Shadow factory and Cold War RSG/RGHQ;
- Sarah Smart from Mid-England Barrow will talk about building the first underground barrow for storage of cremains for thousands of years;
- Judith Hewitt from the Devil's Porridge Museum will talk about the huge WWI munitions factory HM Gretna and the Quintinshill railway disaster;
- Eliot Rix of Berliner Unterwelten will be presenting new work on the Berlin underground ghost stations of the Cold War.

The programme and speakers will be confirmed on the website and as always we are very pleased to welcome short talks or updates from Members – presentation facilities will be available. Short talks can be on any underground space, and can last between 5 minutes and 15 minutes, so send in your suggestions.

Our lunchtime break will be spent in a behind-the-scenes tour of the fantastic Sywell Aviation Museum, on site at the Aerodrome. This will include the WWII and Cold War displays.

Autumn Visits Day, Sunday 17 October 2021

Northamptonshire

After our Autumn Meeting, we have planned a full day of underground visits in the area; confirmed is a guided tour of the Mid-England Barrow with lunch, and a boat trip through the 3000 yard long Blisworth canal tunnel. Other visits are subject to confirmation but we hope to include a visit to Catesby railway tunnel and some Cold War concrete.

Full details, including prices, will be on the website, once the programmes are confirmed. Booking for both events will open in the Summer, using our website.

Non-members are very welcome to attend the Saturday Meeting, but for insurance and logistic reasons, places on the Sunday Visits are restricted to Sub Brit members and are available only to members attending on the Saturday.

Contact Phil Catling on pcatling@subbrit.org.uk

NEWS

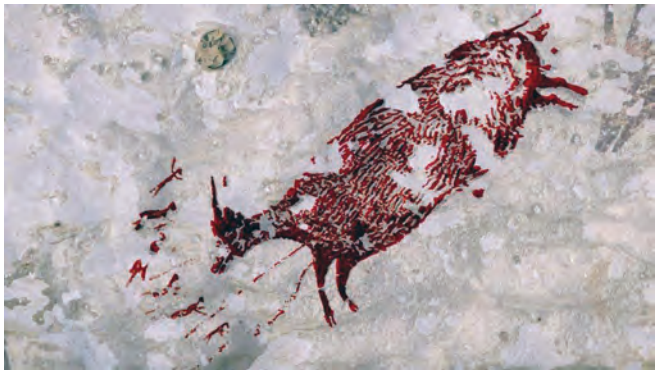
Miscellany compiled by Nick Catford

NEWS – ARCHAEOLOGY

Oldest known animal cave painting found

Archaeologists have discovered the world's oldest known animal cave painting in Indonesia – a wild pig, believed to be drawn 45,500 years ago. Painted using dark red ochre pigment, the life-sized picture of the Sulawesi warty pig appears to be part of a narrative scene. The picture was found in a cave in a remote valley on the island of Sulawesi.

It provides the earliest evidence of human settlement of the region. A dating specialist, Mr Aubert had identified a calcite deposit that had formed on top of the painting, and used Uranium-series isotope dating to determine that the deposit was 45,500 years old. The painting, which measures 53in by 21in, depicts a pig with facial warts characteristic of adult males of the species.



There are two hand prints above the back of the pig, which also appears to be facing two other pigs that are only partially preserved. To make the hand prints, the artists would have had to place their hands on a surface before spitting pigment over it, the researchers said. The team hopes to be able to extract DNA samples from the residual saliva as well.

The painting may be the world's oldest art depicting a figure, but it is not the oldest human-produced art. In South Africa, a hashtag-like doodle created 73,000 years ago is believed to be the oldest known drawing.

SOURCE: *BBC News Reports*, 14 January 2021

German First World War soldiers found a century on

German and French archaeologists believe that they have found a tunnel containing the remains of 200 German soldiers who died after becoming trapped during the First World War. Researchers are almost certain that they had found the notorious Winterberg tunnel, where men of the 111st Reserve Infantry Regiment from the southern region of Baden suffocated during the Second Battle of the Aisne in May 1917.

The wooded slope near the French town of Craonne, 100 miles northeast of Paris, has been surveyed using ground-penetrating radar since December. Specialists are now preparing to use a remote camera to explore the tunnel, before a decision is taken over whether to conduct a dig. The team are fairly confident they have the right location.

German trenches during the First Battle of the Aisne. The men suffocated after becoming trapped in a tunnel during the second battle on the site

It is very difficult terrain, very steep and sandy and there are old munitions everywhere. They will try a technical verification first without anyone having to take a risk. The Volksbund began preparing the search in November 2018 after being alerted to the site by amateur French archaeologists, who had conducted illegal digs there.

The Winterberg tunnel disaster happened when a French shell exploded at its entrance, detonating munitions and trapping the soldiers inside. The battle hampered efforts to rescue the men and the search was abandoned within a fortnight. According to unverified reports at the time, rescuers were deterred by the stench of putrefaction in the tunnel and poisonous gas seeping from the ground. Only three men survived.

SOURCE: *The Times*, 21 February 2021

NEWS – CONSERVATION AND HERITAGE

Dig deep for Churchill's secret army

In the summer of 1940, with Hitler expected to sweep across the Channel at any moment, Churchill ordered the formation of a secret resistance movement. Made up of a shadowy band of armed saboteurs known as "scallywags" and operating out of hundreds of hidden underground bunkers, the British Auxiliary Units were intended as last line of defence.

Now, a fascinating project to find and excavate these bunkers has been launched and researchers are asking the public's help to locate them before they are lost forever.

Andy Chatterton, from the British Resistance Archive, said, "Most people think they know the story of Britain in 1940. That we were a country on our own waiting for the German invasion, but in fact there was a huge amount going on.

"The aim of the Auxiliars, as they were officially known,

was to slow the German advance and to do this in an extremely ruthless way. They were trained to blow up bridges and railways and important buildings, but they would also have been expected to assassinate key figures and not just Nazis. Some had orders to kill British officials, such as local police chiefs, who might have given away secrets under torture.

"Far from the hapless *Dad's Army* image of the Home Guard, the Auxiliars were trained to be the deadliest of assassins. Because they were required to sign the Official Secrets Act many never spoke about their activities after the war and so what we are doing is trying to fill in some of the gaps."

Surviving beds in the Staplefield Patrol bunker in Sussex. Photo Nick Catford

Prof Peter Doyle, a military historian at London South Bank University, who is involved with the study, said: "The British Auxiliary Units recruited people who knew the land, poachers, gamekeepers and farmers. If the Germans had invaded, they would have hidden out in underground bunkers which were stocked with arms and supplies and the plan was that they would steal out and attack at the heart of the Nazi operation. They were warned that they would only have a life expectancy of twelve days."

There were estimated to be around 4,500 volunteers, with between six and eight men per unit. It is estimated that there could be more than 600 bunkers scattered throughout the countryside. The first structures were built in the South East, where it was feared that the Nazi invaders would land, but then they stretched across the country to South Wales and as far as the Outer Hebrides.

When the scallywags were stood down in 1944 many bunkers were filled in or demolished, but scores remain intact hidden in undergrowth in woods and forests. Prof Doyle said: "We recently excavated one in Suffolk and found a heating stove and a lamp."

The team includes Dr Jamie Pringle from Keele University, a senior lecturer in geosciences, whose job it is to identify and excavate the bunkers. He said: "What we need is for people to be our eyes and ears in the countryside and let us know if they think they have spotted one of these structures."

SOURCE: *Daily Telegraph*, 4 January 2021

Editor's note: For more details of the Auxiliars, their operational bases, their secret organisation and their headquarters at Coleshill House, see *Subterranea* numbers 28 and 31 (December 2011 and December 2012).

NEWS – HEALTH & SAFETY

Man rescued from well

A British man, Jacob Roberts, 29, who fell into a well on the Indonesian island of Bali was rescued after six days. He broke his leg after falling into the 4m-deep well in Pecatu village, near the popular southern Bali tourist hotspot of Nusa Dua, while being chased by a dog. The well was dry but due to his injured leg he was unable to get out.

Witnesses say there was a small amount of water in the well which likely kept him alive. His cries for help were eventually heard by a local resident looking for cattle feed nearby. Jacob was lifted out of the well in a stretcher by rescue workers and taken to the Nusa Dua hospital.

SOURCE: *BBC News Report*, 8 June 2020

Sinkhole 'swallowed' Cumbrian farmer on quad bike

A farmer has been pulled to safety from a 60ft sinkhole which "swallowed" him and the quad bike he was riding. The ground opened up as he rode across a field at Bowesfield Farm in Stank, south Cumbria in early March.

He was recovered using ropes and pulley systems in an operation involving fire crew and mountain rescue volunteers. The man, in his seventies, was then airlifted to hospital for treatment to chest and back injuries but was later allowed home.

Ian Westall of Cumbria Fire and Rescue Service said "The ground just fell away with the weight of the bike on that particular spot and he was swallowed up into the sinkhole. We peered down and could see the farmer sat up, and we could just make out the outline of his bike under a mound of earth. I'm sure he was in deep shock."

The opening was about 8ft wide at the top, but below that opened up 'like a wine carafe' which posed additional risk to rescuers. "You've got a lip at the top which went down into a narrow throat, and then there was a large bulbous bottom which opened up 33ft in one direction and 13ft in the other. There are a number of early 19th-century disused iron ore mines in the area, making sinkholes an ever-present danger."

SOURCE: *BBC News,* 5 March 2021.

Fatal landslide in Myanmar jade mine

At least 113 bodies have been found after a wave of mud triggered by heavy rain engulfed people collecting stones at a jade mining site in the Hpakant area of Kachin state in northern Myanmar. The disaster was triggered by a massive landslide pouring into a large flooded pit.

The sides then collapsed sending water and mud surging into the valley below where people were sifting through mine waste and rubble discarded from lorries, hoping to find jade stones.

Myanmar is the world's biggest source of jade but its mines have seen numerous accidents, many involving people who scavenge for stones. More than 100 people died last year alone at mining sites in Myanmar. A landslide at a jade mine in Kachin in 2015 killed at least 90 people.

Myanmar's jade trade is reported to be worth more than £24bn a year. Hpakant is the site of the world's biggest jade mine. A new gemstone mining law was passed last year, but critics say the government has too few inspectors with only limited authority to stop illegal practices.

SOURCE: *BBC News Report*, 2 July 2020

NEWS – MILITARY AND DEFENCE

Gold hunters warned off death camp

The director of the Buchenwald concentration camp memorial has told treasure hunters to stay away after a documentary claimed that Nazi loot may be hidden at the site. Jens-Christian Wagner said excavations in 2019 disproved rumours that a limestone quarry next to the camp still contained valuables taken from Jews murdered at Auschwitz.

A film shown by the broadcaster MDR included claims that a handwritten map pinpointed unopened underground chambers in a quarry. Three entrances have been covered up and unless they were searched, legends of Nazi gold may persist.

US soldiers who liberated the camp in 1945 found 21 tonnes of gold fillings, wedding rings, watches and clocks as well as precious stones and silverware. The SS had moved the valuables from Auschwitz to Buchenwald to keep them away from Soviet troops.

The documentary said two out of eight tunnels blasted into the walls of the quarry at the end of the war had yet to be searched but Dr Wagner said, "All the chambers have been opened."

An estimated 56,000 people died in Buchenwald from torture, starvation, disease and exhaustion. The memorials management has refused to permit digs in the quarry but changed its mind in 2019 after being shown evidence that it contained underground chambers.

It is not known who drew the map, which was unearthed in the US National Archives in Washington in the late 1980s. It points to eight underground bunkers in the quarry where thousands of camp prisoners were worked to death. Only two of those bunkers were previously known about. They were the ones that contained the valuables discovered in April 1945 after camp prisoners pointed them out to US soldiers.

Some of the thousands of wedding rings removed from prisoners to salvage gold

In 2020 a team of historians and archaeologists uncovered four entrances to three small chambers dug into the rock but found only rusty weapons and ammunition, a broken turret and old mining equipment.

Dr Wagner said, "For many years we have had considerable problems there with illegal visits to the tunnel. Sometimes we also find people with metal detectors. Our security guards are vigilant."

SOURCE: *The Times,* 19 December 2020

Iran shows off new missiles in an underground depot

Iran has shown off what it says is a new high-tech 'missile city' with an underground stash of rockets operated by its Revolutionary Guards. The base was inspected by Guards commander Hossein Salami who boasted that it makes up only a 'small section of the great and expansive missile capability' possessed by Tehran.

Footage broadcast by state TV showed rows of missiles in a depot at the underground base, while the head of the Guards' naval unit said the site was equipped to detect enemy signals. The report claimed the base's 'electronic warfare equipment' included radar, monitoring, simulation and disruption systems. Iran has one of the biggest missile programmes in the Middle East and regularly boasts of technological advances in its armed forces.

No location was given for the base, but last year the Guards claimed they had built a number of underground 'missile cities' along the Gulf coastline. Tehran claims to have missiles that can travel as far as 1,200 miles placing much of the Middle East, including Israel, within range.

General Salami – who succeeded the late Qassem Soleimani after his death in a US drone strike last January – bragged that the cruise and ballistic missiles would boost the strength of the Guards' naval forces. Following Soleimani's death, Iran retaliated by firing at US bases in Iraq before the Guards caused a separate crisis by clumsily shooting down a passenger plane. The deaths and attempted cover-up turned the initial wave of public support for the Iranian regime into several days of angry protests.

Iran has continued to spar with the US and last year launched ballistic missiles in an exercise involving a mock-up US aircraft carrier in the Strait of Hormuz, highlighting its network of subterranean missile bases.

SOURCE: *MailOnline,* 16 March 2021

Renovated Chinese air-raid shelter attracts tourists

A recently renovated Wushan air-raid shelter, decorated with oil-paper umbrellas in Fuzhou, the capital of Fujin province in China, has become quite a hit with tourists and local people.

This air-raid shelter is 570 meters long and five to 10 meters wide. To cater for elderly visitors, the previous rugged cement road was replaced by non-slip flagging. Over 300 oil-paper umbrellas in various colors are hung upside down at the top of the passage, of which over 50 umbrellas are equipped with lights.

SOURCE: *China News Service*, 20 February 2021

The Finnish capital's city-within-a-city

Nearly 200 miles of tunnels snake beneath Helsinki, providing a weatherproof subterranean playground for the Finnish capital's residents and visitors. Yet hidden behind the bright lights of the underground attractions – which include a museum, church, go-kart track, hockey rink, and more – are emergency shelters fitted with life-sustaining equipment: an air filtration system, an estimated two-week supply of food and water, and cots and other comforts. The shelters reflect a chilling geopolitical reality for a small country that shares an 833-mile border with Russia, its longtime nemesis.

Temppeliaukio Church is one of several subterranean sites that attract locals and tourists alike. Completed in 1969, its stunning features and superb acoustics have made it one of Finland's most popular architectural attractions, drawing more than 850,000 visitors a year

Thought to be the world's only city with an underground master plan, Helsinki began excavating tunnels through

bedrock in the 1960s to house power lines, sewers and other utilities. City planners quickly realized that the space could also be home to retail, cultural, and sporting attractions – and that it could shelter the city's population of 630,000 in the event of another invasion from the East. The building of the tunnels expanded with new purpose.

During the Cold War, Helsinki stood at the crossroads of the East and West, one of the last major outposts separating the NATO and Warsaw Pact superpowers. In recent times, Russian President Vladimir Putin has warned Finland more than once against joining NATO, an uneasy reminder of past tensions.

Yet on a typical winter day, when the city receives only a handful of daylight hours, Helsinki's underground master plan becomes manifest as a way to navigate the city, guiding residents and tourists along bright underground passageways lined with markets and shops, to metro stations and the central railway station, while providing shelter from the elements.

SOURCE: Atlas Obscura, 22 March 2021

Oxgate Admiralty bunker in north London to be demolished

In March Sub Brit was contacted by the Heritage Officer at Brent Council. He told us that there is a planning application in to demolish the WWII Oxgate bunker at the junction of Edgware Road and Oxgate Lane and replace it with a tower block.

Oxgate is locally listed but has no statutory listing and Sub Brit's comments on the planning application have been invited. English Heritage and the 20th-Century Society have both been approached and had no comments to make. Nick Gould, who has recently joined the Sub Brit Committee, is going to put forward a letter objecting to the demolition.

External view of Oxgate, the only London citadel to retain its surface buildings. Photo Nick Catford

The applicants have commissioned a heritage report (which is available to view in two parts from the planning application) and its summary conclusion is that the bunker has insufficient value to be retained. It is in bad condition and was never used, and was replaced by the central London Admiralty Citadel off Horse Guards Parade which is protected. They also say that Paddock nearby is a better candidate for preservation, given its historic role. Oxgate, however, is the only one of the three northwest London bunkers to retain its surface buildings.

SOURCE: Brent Council, March 2021

Editor's note: We are hoping that it may be possible for Sub Brit members to visit Oxgate later this year.

Drakelow tunnels to be converted into a bonded warehouse and wine store

London City Bond Limited has been given the go-ahead for a change of use of Drakelow Tunnels, beneath Kingsford Country Park, near Kidderminster, after a successful appeal against plans that were originally refused. The company has also been granted permission for a change of use to provide a museum at the site.

Wyre Forest District Council refused a planning application last year because of concerns about the number of movements of heavy goods vehicles, the number of parking spaces and vehicles using narrow local roads near the Green Belt site. But London City Bond Limited appealed against refusal of planning permission in November. Now planning inspectors have allowed the appeal for the development which will see two portacabins put up to provide office space and security accommodation, car and cycle spaces and new entrance gates and fencing.

This area was used as an RSG during the early years of the Cold War. Photo Nick Catford

An existing metal structure will be refurbished to provide a reception canopy and work carried out to a disused electricity sub-station to provide alternative bat habitats. The go-ahead for the development will also see a change of use of part of the tunnel space for a museum.

SOURCE: *Express & Star,* 12 March 2021

Editor's note: For full details and photos of the Drakelow complex, see *Subterranea* 26 (April 2011).

Police search tunnels in Dover as part of the Sarah Everard murder enquiry

Kent police conducted a search operation in a network of tunnels and passages in Dover in connection with the Sarah Everard case. The 33-year-old went missing in early March and human remains were discovered in Ashford on 11 March.

Suspect Wayne Couzens, a 48-year-old Metropolitan police officer from Deal, used to work at his family's car garage BCB Dover on the Western Heights. The garage, near the Knights Templar church, was run by the family for 48 years until 2015. A network of WWII tunnels nearby was the focus of a major police search. Miles of tunnels, a maze of rooms and military fortifications were examined by police teams at the top of the White Cliffs overlooking the Port of Dover.

Metropolitan Police officers examined the entrance to a network of tunnels and a deep shelter running underneath the garage. The entrance is blocked with a metal gate with a new padlock. The tunnels are part of a 19th-century ammunition magazine that was extended into a shelter during WWII.

Police also began searching a gun emplacement – St Martin's Battery – directly in front of the garage. Officers with specialist electronic search equipment also made a preliminary assessment of the Western Heights, a massive fortification dating back to the 18th century which can be reached by a footpath from the garage. The fortification, owned by English Heritage, contains hundreds of rooms and passages.

SOURCE: *Kent Live*, 12 March 2021

New Zealand's last line of defence in WWII

In a suburban hillside in Nelson, the oldest city in New Zealand's South Island, a tangible reminder of the last major threat to New Zealand from an invading force has sat quietly for nearly 80 years. An underground bunker, hurriedly built there in 1942, was intended as one of the country's last lines of defence.

It was the growing threat from Japan that sparked the rush to fortify New Zealand's defences. Japan's air strike on the US naval base of Pearl Harbor in Hawaii in December 1941 was a turning point in World War II. At the start of the war, the conflict was remote from New Zealand because it was all in Europe and North Africa, but after Pearl Harbor, it was a different story.

The attack triggered the Pacific War, bringing the threat of conflict much closer to New Zealand shores. In February 1942, the British stronghold of Singapore fell to Japan, as Japanese forces advanced down the Malay peninsula. Japanese submarines started "nosing around the place", launching reconnaissance flights over the North Island and attacking Allied warships in Sydney Harbour in Australia. Sirens, aeroplanes, tanks and barbed wire on the beach were among vivid memories, along with the installation of two guns above Haulashore Island, just off the Nelson coast.

About 14 secret air bases were set up in New Zealand to enable the US air force to get out of Australia, and establish in New Zealand as a last stand. Japan wanted to prevent the US navy from establishing a base there.

Unbeknown to most people, the Royal New Zealand Air Force (RNZAF) also decided in February that year to build 17 underground operations rooms. The bunker in Nelson was intended as a fallback bomber operations centre, should the RNZAF base at nearby Nelson airport come under attack. The fleet of around twenty Hudson bombers in Nelson patrolled the Cook Strait, and were considered to have long reach.

Nelson was one of just five fallback RNZAF stations that were actually built in New Zealand. More than 17 tonnes of reinforcing steel was required for the bunker, which has walls of reinforced concrete one foot thick. A dogleg entrance (designed to prevent ordnance like hand grenades getting in) leads to two main chambers, and a 6m high escape hatch. The largest chamber, just over 7m by 8m, is thought to have been partitioned into several rooms.

Fires lit by vandals have blackened the walls of the bunker, which was also used for training by the local fire brigade. Its main entrance is locked by the current landowners, who use the rooms mainly for storage.

The RNZAF itself never used the bunker. The threat from Japan subsided throughout 1942, as American, New Zealand and Australian forces pushed the Japanese back up towards Singapore.

SOURCE: *Stuff,* 23 January 2021

New buildings listed to commemorate 80th anniversary of Battle of Britain

An air-raid shelter at St John's primary school, Redhill, covered in murals painted by the children depicting scenes from Treasure Island, Robin Hood, and Gulliver's Travels; a pillbox cleverly disguised as a roofless cottage in Northumberland to protect the area from German invasion; a rare Chain Home radar defence tower in Essex; and a war memorial to commemorate civilians in Dorset who lost their lives have been granted protection to mark the 80th anniversary of the Battle of Britain.

These four new listings by the Department for Digital, Culture, Media and Sport (DCMS) on the advice of Historic England are highlighted alongside three other sites which have been either upgraded or relisted to mark Battle of Britain Day (15 September 2020). In their variety, they show how the Battle has left its mark across England. Although the Battle of Britain took place between July and October 1940, the date of 15 September is widely seen as when Britain's RAF Fighter Command gained a decisive victory over the German Luftwaffe.

Air-raid shelter at St John's Primary School, Redhill, Surrey

Two sites have been newly upgraded from Grade II to Grade II*, including another Chain Home Transmitter Tower – at RAF Stenigot in Lincolnshire (See article on page 35). Standing at 110m, the same height as St Paul's Cathedral in London, the tower and the newly listed example in Great Baddow, Essex, are rare surviving physical components of the world's first radar air defence network and among very few from the network to remain standing today. Built in the late 1930s, it is a reminder of the widespread anxiety during this period about the impact of aerial assaults on the UK.

Also newly upgraded to Grade II* is an important memorial in Ruislip, West London to the Polish Air Force who made a major contribution to the Allied war effort during the Second World War and particularly during the Battle of Britain.

The final highlighted site is the Spitfire Club at RAF Tangmere in West Sussex – the headquarters for Number 11 Group of Fighter Command which played a pivotal role defending London and the South East in the Battle of Britain. The site has been relisted, now also with information about its connection to the Battle of Britain added to its list description on the National Heritage List for England.

SOURCE: Historic England website, 14 September 2020

Henley air-raid shelter, Northfleet, Kent under threat from developer

A local campaign is underway to save a network of air-raid shelter tunnels threatened by a housing development in Crete Hall Road, Northfleet.

Constructed by telegraph cable company WT Henley in 1939, the twisting passages were used as an air-raid shelter to shield from German bombing during the Second World War. The tunnels were crafted into old caves within the Rosherville Gardens chalk-pit with at least six entrances and clear instructions emblazoned on the walls.

However, the Cable Wharf housing development, known as Northfleet Embankment East as part of the Ebbsfleet Garden City project, could close the tunnels for good.

The World War II air-raid shelters are cut into the toe of the chalk cliff face along the boundary and currently sit in the ownership of Gravesham Borough Council. Part of the WT Henley building was demolished last year to make way for the development; the rest of the building is in poor condition..

Ian Mcfaul, technical director for Keepmoat Homes South Midlands, the company behind the plans, said: "The heritage of the Cable Wharf development is a key focus of Keepmoat Homes. Through the planning process we have engaged with all key statutory stakeholders to develop a comprehensive Heritage Management Plan.

"Keepmoat Homes have worked with Gravesham BC and Kent County Council Heritage to ensure we provide adequate access through the delivery of the development due to the current access being limited due to previous land raise activities. Through the development Keepmoat Homes are actively promoting the existing heritage through heritage trails and interpretation boards for public enjoyment and education."

Rosherville Gardens was opened in 1837 and at one point was drawing in a million visitors a year – and was considered to be the 'Euro Disney of the Victorian age'. The space, which used to sit in Crete Hall Road, where the development is currently being built, featured a famous bear pit, an archery ground, a lake, a maze, a lookout tower, a monkey house, acrobats, a dance hall and a cave that would have housed a 'hermit-type' actor or fortune teller.

SOURCE: *Kent Online,* 29 November 2020

Editor's note: An extensive article about this shelter is currently being prepared for a future edition of *Subterranea.*

Secret weapon bunker museum in Vietnam

In 1966 during the Vietnam War, Tran Van Lai, a politician, bought a house at 287/70 Nguyen Dinh Chieu Road in District 3 of what was then Saigon. Over the next few months, he constructed a secret cellar without the knowledge of his family. He used the secret hideaway to store weapons that would be used in the 1968 attack on the Royal Palace. This event was better known as the Tet Offensive.

To avoid suspicion, he put all the dirt collected from digging the bunker into boxes and disposed of them using his car at night. The weapons were also brought in

and out in a similar manner, hidden in bamboo cases or rugs. Weapons included TNT, C4 explosives, detonators, rocket launchers, guns, and hand grenades.

Today, the house is a tiny museum and a witness to an important part of Vietnamese history. It was classified as a historical cultural relic in 1986 by the Ministry of Culture. The coffee shop next door also contains secret passages and is owned by Tran Vu Binh, the son of Van Lai.

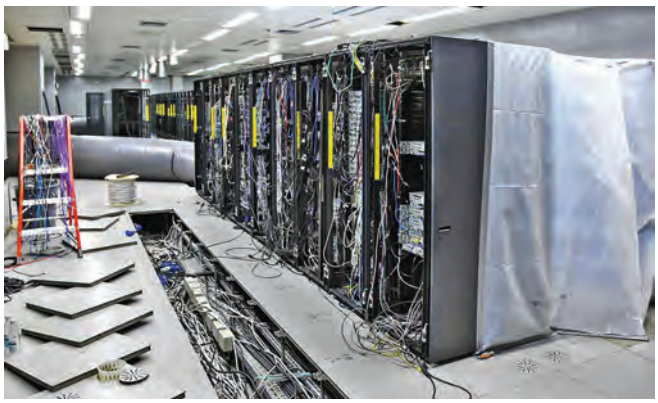
The museum can be difficult to find and is located at the end of a busy alleyway. The best way to find the museum is to look up Nguyen Dinh Chieu Road on Google Maps. The museum is open very sporadically and has no official opening hours, so you might have to be lucky or pull some strings to get in. The best bet is to ask the owner of the coffee shop next door to arrange a viewing. There is no official entrance fee, but donations are highly encouraged.

SOURCE: Atlas Obscura, March 2021

NEWS – MISCELLANEOUS

Cold War bunker 'base for 249,000 cyber crimes'

A team of cyber experts appeared in court yesterday charged with enabling more than 249,000 crimes from a renovated five-storey-deep Cold War bunker in Germany. The eight suspected criminals have been accused by German prosecutors of hosting illegal drug marketplaces as well as websites that sold child pornography, counterfeit money and cyberattacks for hire.



The "Cyberbunker" hosting service was operated in a former Nato bunker on the outskirts of the German town of Traben-Trarbach from the end of 2013. Prosecutors allege that the bunker was used to host thousands of websites which facilitated drug deals worth millions of pounds.

Four Dutch, three German and one Bulgarian suspect ranging in age from 20 to 60 are standing trial after police raided the bunker last year. The main organiser of the bunker is alleged to be a 60-year-old Dutchman who acquired the site in 2013. He has denied knowledge of the websites operating on the bunker's servers.

German police seized more than 200 servers and $41 million of funds when they raided the bunker complex last September. Prior to being used as server farm, the bunker was the headquarters of the Bundeswehr's meteorological division and housed up to 350 employees.

Prosecutors have alleged that the servers were used "exclusively for illegal purposes". The Cyberbunker has been accused of operating as a "bullet-proof" hosting provider, allowing customers to run illegal websites without vetting their contents. The trial is expected to last until the end of 2021.

SOURCE: *Daily Telegraph*, 20 October 2020

Norwegian underground vault to preserve the world's treasures for a millenium

Five centuries from now, should our descendants wander into an abandoned coal mine on the Svalbard archipelago, they would find a perfectly preserved copy of Edvard Munch's *The Scream*.

Come nuclear apocalypse, harrowing pandemic or climate catastrophe, a digitised collection of the world's cultural treasurers should survive in the vault of a millennium, its founders say. The Arctic World Archive (AWA) on the island about 500 miles north of the Norwegian mainland is a human insurance policy against global disaster.

Even if civilisations pull through and our species does not ruin the planet, it will live on. Books will rot in the long run, and paintings will fade. Piql, a Norwegian company, is trying to solve this problem with reels of photo-sensitive film, buried 300m underground in one of the most remote regions of the world.

Artworks, photographs and precious texts, ranging from early manuscripts of the gospels to the original celluloid frames of *Bicycle Thieves*, a classic work of Italian cinema, have been stored. The Norwegian government deposited copies of artefacts from the National Museum in Oslo, including *The Scream* and Harald Sohlberg's 1914 painting *Winter Night in the Mountains*. The Vatican has entrusted the AWA with a manuscript of Dante's *Divine Comedy.*

At the archive, scans of the originals are turned into QR codes, like those used to encode information for smartphones. The QR codes are then printed onto reels of 35mm polyester photographic film. along with simple instructions at the start of each reel for deciphering them.

Tests suggest that the film could remain legible in the dry Arctic vault for at least 500 years, and probably 1,000. Piql hopes this could be extended to as long as

two millennia. "Film is very durable," the company said. "It survives for hundreds of years if well cared for." The novelty consists not so much in the film itself as in the way it is imprinted. The information is scattered and repeated across each frame, meaning that parts can be damaged without erasing the whole.

In anticipation of a far future in which 21st-century QR codes may be as unintelligible as the ancient Minoan Linear A script is today, the reels also begin with simple instructions for deciphering their contents. Since the facility opened in 2017 governments, cultural foundations and private companies from at least fifteen countries have deposited data in its boxes.

The reels include copies of the Brazilian constitution, the Mexican declaration of independence, Norwegian folk stories, and X-rays of the Ida fossil, a 47 million-year-old mammal said by some palaeontologists to be the missing link between primates and other animals.

SOURCE: *The Times,* December 2020

Basement bar preserved beneath Loughborough shopping centre

Hidden beneath Loughborough's Carillon Court shopping centre is this little gem – a once popular drinking hole called *The Green Man*.

Below ground in the basement bar *The Green Man*'s benches are still intact, along with giant murals depicting scenes of castles and knights. The entrance to the alehouse was closed 22 years ago and its doors later walled up during renovation work at the shopping centre.

At the time, Carillon Court bosses said it would cost too much to create a new access, so the bar may never be used again. At present the bar can only be accessed down a ladder from a manhole in the entrance to the Game store.

On its walls are three huge murals painted by artist David Parry which have remained untouched. There is also a bag of peanuts dating from 1993, as well as scores of empty beer glasses. Since it closed, potential developers have viewed the site but decided against taking it on due to the cost.

SOURCE: *Loughborough Echo,* 29 December 2020

Dartmoor water treatment works could become shrine for the dead

Hidden on the edge of Dartmoor near a village called Belstone is an underground water treatment works that has been unused for decades. The bunker near Okehampton used to be a water treatment works, however it hasn't been used for many years – but now there are plans in the works to transform it into a respectful shrine for people who have passed away.

The former treatment plant was originally owned by South West Water, and then bought by South Devon architect Neil Worrell, who originally planned to use it as a hostel or a mausoleum. However, he decided to auction the bunker off in 2018, which is when Ashes To Dartmoor bought it. The site was sold for £28,000, according to Auction House.

The property is two huge underground storage tanks and works which were used for storing water off the moor and filtering it to make it safe for human consumption. It is over 100ft long and 20ft wide and has numerous skylights from when the facility was used to extract the radon gas from the water.

In 1957 the North Devon Water Board obtained permission to sink a number of test boreholes to ascertain the viability of water extraction. These explorations led to the 1959 North Devon Water Act in which permission was given to extract supplies from Taw Marsh. The widespread occurrence of granite in the area meant the water was found to be radioactive thanks to the association of radon with granite.

The water company installed an aeration tank in order to remove the radon and carbon dioxide along with a treatment works. The works supplied Exeter with drinking water for decades. Water abstraction ceased in the late 90s and the building lay unused until Ashes To Dartmoor purchased it in 2018.

SOURCE: *Devon Live*, 16 January 2021

The world's largest underground business complex is underneath Missouri.

There are a number of advantages to keeping things underground. The temperature remains constant, energy costs are lowered, and – in the massive, 55,000,000-square-foot space known as SubTropolis – there is a whole city of workers who can keep your goods safe.

SubTropolis in Kansas City stores everything from a USPS collection of millions of postal stamps and the original film reels of *Gone With the Wind*, to a series of artificially lighted, man-made habitats used by Earth Works to demonstrate science to students.

Mining in SubTropolis began in the 1940s, and the empty space grew under the limestone bluffs on the Missouri River. By 1960, the owners realized that they had an enormous area they could rent out for business operations. The dubbed their underground city "SubTropolis" and called it "the World's Largest Underground Business Complex". SubTropolis has nearly seven miles of illuminated paved roads, and semi-trucks drive throughout the underground.

Trucks are loaded and unloaded in perfect weather conditions. It's truly a green environment that is probably using about 75 percent less electricity underground than a similar sized above-ground facility. Whether it's electronics or whether it's food, you don't have temperature and humidity fluctuations and so you don't have any condensation or moisture building up in anything.

The entire site is private property, and is patrolled by security, although you can drive on the main road in front of the bluffs. There is no visitor center, but you can drive through SubTropolis Monday through Friday from 6 am to 6 pm. There is a paintball place called Jaeger's in one of the caverns, if you're keen to get inside.

SOURCE: *Atlas Obscura*, January 2021

NEWS – MINES AND MINING

Simon Hughes dies at 67

Welsh mines expert and author Simon Hughes passed away on 10 December, aged 67. He was a noted authority on Ceredigion mines and along with fellow members of the North Cardiganshire Mining Club which he helped form in May 1966 – a year after he and a few friends had started exploring the mines around Talybont.

Simon's main passion was collecting as much information as he could about the various old mine sites in the area. He considered the underground exploration of old workings as necessary for the production of these records.

His contribution to mining history is enormous. Amongst his many publications are three in the British Mining series on The Cwmystwyth Mines (BM No.17), The Goginan Mines (BM No.35) and The Darren Mines (BM No.40). Without Simon it is debatable whether we would have underground access to Cwmystwyth and other mines today, as he opened up entrances, dug through collapses and even de-watered No.9 Adit at Cwmrheidol.

SOUURCE: *Below*; Journal of the Shropshire Caving & Mining Club, Spring 2021

The last of Britain's coal miners – keeping a Forest tradition alive

Every weekend teenager Kealan joins his dad underground in a coal mine in a bid to keep a centuries-old tradition alive. The schoolboy hopes to help safeguard the historic rights of Foresters to mine coal within the Forest of Dean at the age of 21.

New laws designed to halt climate change had threatened the birthright of all those born within the original Forest of Dean boundaries. Although not able to become freeminers, Kealan and his father, Mark, are among a team of five who work a small mine called Forester's Folly on behalf of freeminer Mike Howell because they want to keep the tradition alive.

Last summer Government Minister Rebecca Pow from DEFRA agreed to make the Forest of Dean freeminers exempt from new laws banning the sale of coal by 2023. It is a victory for the The Royal Forest of Dean Freeminers' Association which says the small amount

of money they make from selling the coal is needed to keep the mines open.

Kealan and his father Mark

The Clean Air Act is expected to close surviving commercial coal mines in this country by making them uneconomic, leaving the Forest the only working coalfield in the UK. These days there are only six mines and around 100 surviving freeminers, not all of them still working. Their rare tunnelling skills are still in demand for emergencies and heritage projects such as the mine at the Black Country Living Museum in Dudley.

A Heritage Lottery-funded project, the Forester's Forest, is trying to keep it alive for future generations such as Kealan by supporting the industry. It is helping to provide statutory training demanded by the Health and Safety Executive, the mines inspector and the coal authority for those who work underground and have to obey the same rules as commercial ventures.

SOURCE: *Gloucestershire Live*, 11 July 2020

Mine water flood in south Wales

On the evening of Thursday 21January over 80 residents of Skewen near Neath, Port Talbot, Wales were evacuated following serious flooding. Eight streets of the village were left under water during Storm Christoph when water erupted from old mine workings on the hillside near the junction of Goshen Park and Drummau Road.

The ocherous water also polluted the nearby Tennant Canal. There were several former colliery sites near the village that operated in the 19th and early 20th century that stretched between Neath and Llanelli on the western side of the South Wales coal field.

The consensus was that due to the heavy rainfall water had built up underground and was unable to drain away as it normally did, rising to a point where it found a weak spot and burst out of the hillside at the site of a former shaft. There are about 13 shafts recorded within 820ft of the one in Goshen Park.

SOURCE: *Below*; Journal of the Shropshire Caving & Mining Club, Spring 2021

Bradley open-cast mine closes

The surface mine in Bradley, near Dipton, County Durham, opened in 2018 to extract 500,000 tonnes of coal, with approximately 340,000 tonnes collected. Its owner, the Banks Group, has stopped working the mine after plans for an extension were rejected, a decision welcomed by environmental campaigners. But it is the worst possible news for the miners who work at Bradley, particularly as the UK still has a demand for almost eight million tonnes of coal a year. This demand is mainly satisfied by imports that come from Russia and the US.

The company is awaiting a government decision on plans to open a mine at Highthorn, near Druridge Bay, Northumberland and at Dewley Hill, to the west of Newcastle. A total of 32 people work at the site in County Durham, which is set to be turned into farmland and a nature reserve.

Hartington mine in Derbyshire is one of the last surface mines to remain operational. There are also some small operational underground mines in Cumbria and the Forest of Dean and a handful of small mines operating in Scotland and Wales. But their days too are numbered.

The last deep mine, at Kellingley in North Yorkshire, closed five years ago. Since then the only home produced coal has come from open-cast mines like Bradley.

SOURCE: Sky News Reports, 17 August 2020 and BBC News, 18 August 2020

Cave divers in Mexico find ancient Mayan ochre mine

Cave divers on Mexico's Yucatan peninsula have found evidence of a mining operation for red ochre started 12,000 years ago and lasting two millennia.

The dive team explored about 4.3 miles of subterranean passages in three separate cave systems, with mining spanning more than a half-mile. More than 100 dives totalling more than 600 hours in Quintana Roo state

turned up numerous mining artefacts in pristine condition, including ochre extraction pits, digging tools like hammer stones and small piledrivers made of stalagmites, markers that helped the miners navigate the extensive cave network and hearths used to provide light.

The caves became submerged roughly 8,000 years ago amid rising sea levels after the last Ice Age. Researchers had previously found human skeletons in the caves but had not identified why people were there.

SOURCE: MSN News Report, 3 July 2020

County Durham homes to be heated by mine water

The 1,500 residents of the new South Seaham Garden Village, County Durham will soon be warmed by water from a disused mine. The potential is large because around a quarter of Britain's homes sit on coalfields. Although some mines won't be suitable, it's hoped that many will be able to supply consistent warm water. For the Coal Authority, which manages disused pits, the idea could turn a liability into a profit.

Warm water is pumped from the mine. It goes through a heat exchanger unit, a device about the size of a fridge which is fitted in people's homes. The heat from the exchanger is passed through a heat pump which in tum warms the water used in central heating. Mine water does not enter people's central heating and is pumped back underground so it can warm back up and be reused.

There are some potential problems with mine water schemes: uncertain geology, hydrology, and mine water that can be highly corrosive. It may also contain high quantities of iron or manganese which can clog up pumps and heat exchangers.

A small trial heating scheme in Scotland closed after it became too costly to maintain. It is believed that maintenance can be better handled by large projects such as one underway in Gateshead town centre. It will heat council buildings, a new care home, and up to 1,250 new homes.

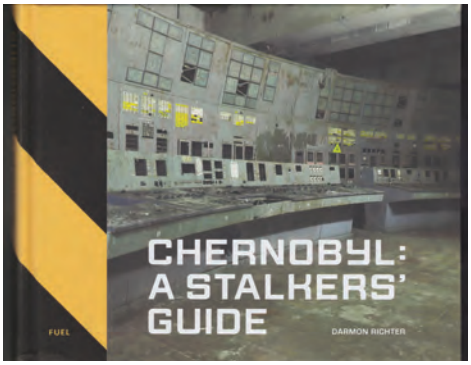
Plans are also underway at Rugeley in Staffordshire, where a former coal-fired power station will be turned into a village of 2,300 homes heated partly by water from disused shafts. Currently 14 mine water heat schemes are planned for the north, with seven in the rest of England. Five are planned for Scotland and four for Wales – with a scheme at Caerau, Bridgend the furthest progressed.

SOURCE: BBC Report, 9 June 2020

NEWS – PUBLICATIONS

Chernobyl: A Stalkers' Guide

RICHTER, Darmon, 2020, Fuel Design and Publishing, 248pp, [ISBN: 9781-9162-1842-0], £24.95



Book review by Martin Dixon

Darmon Richter is a British writer and photographer with a fascination for ideological architecture. He has a particular affinity with communist-era buildings and memorials. After multiple trips to the exclusion zone surrounding Chernobyl, he has written a book which goes way beyond architecture to explore (both figuratively and literally) the story surrounding what was and is the world's worst nuclear power plant disaster, in April 1986.

The volume's scope is more extensive than the usual coverage of what happened at Chernobyl, and covers the time period before the construction of the power station, going right up to the present day. The book starts with emergence of the 'Atomic Era' and the range of books and films that predicted the apocalypse that would follow the intentional or accidental deployment of nuclear weapons. In fact, the 'Stalker' of the title comes not from the unwanted surveillance or harassment of an individual, but from a Soviet-Russian Science Fiction novel.

Reactor 4 control room

Published in 1972, *Roadside Picnic* (Arkady and Boris Strugatsky) tells of an alien invasion of Earth and of those who enter the prohibited and contaminated zones they inhabit to steal artefacts. The Russian term for these trespassers is *Сталкер* which translates literally as Stalker. In contemporary Britain, 'urban explorer' is perhaps the nearest equivalent – especially as only a percentage of Stalkers are involved in the theft of objects.

Chapters that follow go on to describe the building of the Chernobyl Nuclear Power Plant (officially the Vladimir Ilyich Lenin Nuclear Power Plant) and the town of Pripyat, the disaster itself and many aspects of more recent life. Their scope includes outlying villages, abandoned monuments, local residents, Slavutych (the replacement settlement for Pripyat), the growth of tourism and even extends to neighbouring Belarus which has its own Radio-ecological Reserve.

The author's exploration of the Chernobyl Nuclear Power Plant itself includes the Control Room for Reactor 4; this is where the fateful events of 26 April 1986 unfolded. Amazingly, Richter also gains access to the New Safe Confinement or New Arch – a very rare privilege. Once dismantling of the 1986 Shelter Object or Sarcophagus begins, this will be strictly off-limits. Each chapter is a very readable essay rather than a stark history or mechanistic description of sites. Maps and plans of the key areas are well presented at the start of the book.

WWII memorial

A particular strength is the photography throughout, with perhaps fifty percent of the available space being high quality photographs of the Exclusion Zone and beyond. Some of Richter's journeys were made as a tourist, some as a guide and some as a Stalker. Many of the sites featured will be completely new even to those who have visited Chernobyl, unless they have enjoyed several days exploring the region. The photos brought back happy memories of my own extended trip to the area in 2019.

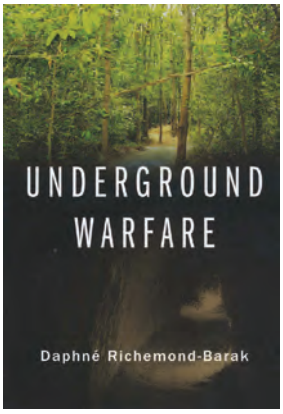
I found little to criticise along the way. Perhaps the accounts of the disaster itself and the immediate aftermath are a little brief but other volumes are available which concentrate on this aspect. The compact size of the book (20 x 16 cm) makes it portable but it also means that some of the photos are a little small; a larger format would also have allowed a larger text size. Extensive references are provided but the addition of an index would have been helpful.

Overall I'd score the book highly and if you were only going to acquire one book on Chernobyl then I'd thoroughly recommend this one – acting as it does as guide book, history lesson, architectural guide, political primer and photo album. Whether you've visited Chernobyl half a dozen times or only dreamed of it, there is almost certain to be something for everyone inside.

Underground Warfare

RICHEMOND-BARAK, Daphné, 2018, Oxford University Press, 296pp,

[ISBN: 9780-1904-5725-9], £30.49



Book review by Martin Dixon

Underground warfare has been written about previously, but usually by historians in relation to specific campaigns, or by enthusiasts and archaeologists recording what still exists. This welcome volume examines the current threats posed by underground warfare against historic, legal and operational backdrops.

Daphné Richemond-Barak is Assistant Professor at the Lauder School of Government, Diplomacy and Strategy in Herzliya, Israel. She is also Senior Researcher and Head of the International Law Desk at the International Institute for Counter Terrorism (ICT) at the Interdisciplinary Center (IDC), also in Herzliya. She has pulled together many strands of underground warfare for this new and ground-breaking book.

After an introduction summarising the challenges and complexities of subterranean combat, a historic overview is presented. This ranges from the use of siege mining to destroy fortifications that dates back at least 2,500 years to recent conflicts in Afghanistan and Syria. In between there are the major conflicts of the 20th century, including the tunnellers of World War I, the entrenched Japanese in World War II and the extensive networks used by the Viet Cong. Modern conflicts have added the complexity of cross-border excavations and the use of subterranean space by civilian or paramilitary forces.

Underground space during conflict can be used as passive defence (eg. Derinkyu or the French *muches*), as active defence (eg. Maginot Line), as an offensive tool (Word War I mine explosions), for command and control purposes (World War II Fighter Command), or to protect materiel and facilities (magazines and communication centres). Present-day use is if anything more complex, with underground space being used by terrorists and other non-state fighters in asymmetric warfare waged against more powerful states.

The scope of this book is largely limited to the use of underground space (predominantly tunnels and networks rather than cuboid) on or in close proximity to what would traditionally be described as the battlefield. In many current conflicts, however, this can be any location where opponents of a regime or movement might be encountered. The book therefore has little to say on many aspects of how underground space has been and is used during conflict. So civilian shelters, Intercontinental Ballistic Missile (ICBM) silos, command and control sites and protected communication infrastructure are largely out of scope.

A brief section follows which describes the complexity of laws governing domestic and international ownership of underground space. Different countries have different codes – does a landowner, for example own everything beneath their land or are there exceptions for items such as minerals, water and utilities. Comparisons are made with the law on ownership of sea, air and space around and above territories.

The next section of the book addresses the detection, monitoring and elimination of underground sites. Detection methods described range from high-tech Ground Penetrating Radar (GPR) to the use of animals. The latter includes the slightly unbelievable story of the United States using bed bugs in Vietnam to detect the presence of the enemy. Monitoring of underground construction and structures is increasingly technology-based but physical examination of existing infrastructure such as sewers and transport systems is important, particularly in urban environments.

In terms of elimination of the underground threat, many techniques used in the past such as flame-throwers or gas would raise legal issues today. GPS 'bunker buster' bombs are discussed as the current preferred instrument of destruction.

The laws and rules that 'govern' warfare have developed over the centuries. Initially these covered conflict at land and sea but over the last century they have expanded to cover war in the air and more recently in space and even cyberspace. One aspect that has not been studied is subterranean conflict or underground warfare. Daphné Richemond-Barak corrects this omission within this comprehensive volume.

A chapter examines under what circumstances underground activity – particularly where tunnels extend across international boundaries – can provide justification for war (*jus ad bellum* in legalese). This is followed by a detailed examination of what constitutes legitimate use and destruction of the underground during warfare (*jus in bello*); for example where underground refuges are close to civilian settlements.

Overall the book benefits from comprehensive references and a well-structured index. Pulling out the many acronyms into a separate list would have made this even better. There are no photographs and only a couple of tables. Some of the former and more of the latter would have made the descriptions and commentary more accessible.

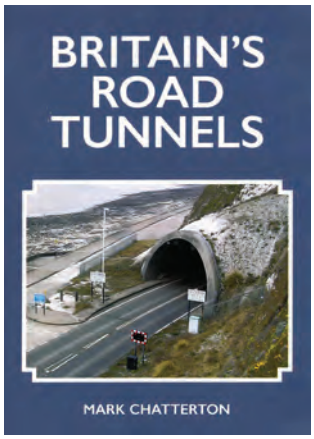
I can't comment on the specialist legal terminology used in places but a couple of more technical terms caused me some confusion. 'Mining' is used throughout only in its sense of offensive underground explosions rather than in terms of excavation. 'Cement' is used throughout when in almost every case 'concrete' would be the accurate term.

The broad conclusions of the book are that underground warfare is here to stay and will be increasingly used by non-state actors (guerrillas) in urban environments. It is a pity that one aspect of what we find so intriguing is still being used to destroy fellow humans.

All in all, this is a hefty but well-written academic volume. The legal backdrop will not be to everyone's taste but overall it fills a valuable void (pun intended) in the literature of warfare

Britain's Road Tunnels

CHATTERTON, Mark; 2020, *Britain's Road Tunnels,* Amberley, 96pp. [ISBN 9781-3981-0028-2] £14.99



Book review by Tony Hall

Mark Chatterton developed his interest in road tunnels in the 1950s after being driven by his father through the Mersey Tunnel. The fascination, which has never left him, planted the seed of this interesting little book which he has spent the last ten years researching and photographing.

In his helpful introduction, Chatterton attempts to answer the main question of what actually constitutes a road tunnel and gives the official Department of Transport definition ("…a subsurface highway structure enclosed for a length of 150 metres/164 yards"). There is also discussion about the differences between tunnels, bridges and underpasses; and the inconsistency of assorted definitions. He also informs us that, unsurprisingly, the majority of road tunnels are to be found in London and the Southeast.

For those of us unfamiliar with the terminology of tunnel engineering, a useful glossary precedes the gazetteer of tunnels, which in the first six chapters covers tunnels on Major Trunk Roads, in City Centres, at Airports, Railway Stations, Shopping Centres and Other Road Tunnels.

Chapters 7 and 8 will be of particular interest to members of Sub Brit as they are entitled "Road Tunnels Closed to the Public" and "Former Road Tunnels". Although oddly, there is no mention of London's Kingsway Tram Tunnel.

The penultimate chapter lists plans for some "Future Road Tunnels" such as Irish Sea crossings, a Birmingham Super Tunnel and a Trans-Pennine Road Tunnel, some of which may never see the light of day (pun intended) for one reason or another – although it looks as if the Stonehenge Tunnel and Lower Thames Crossing (Thames Gateway Crossing in the book) will now be going ahead. Chapter 10 provides details of some websites of interest to tunnel enthusiasts including, of course, that of *subbrit.org.uk*

Mark Chatterton obviously knows his road tunnels, most of which are distantly familiar to me after a working life driving across the UK. His descriptions are clear, concise and informative, the photographs are of good quality and the typeface is easy to read.

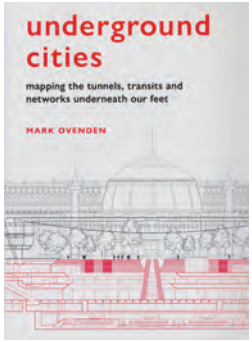
My main criticism lies in the choice of photographs, a large proportion of which depict tunnel entrances of fairly boring oblong concrete construction whereas visual delights such as the portals of Swainsley Tunnel on the track of the former Leek & Manifold Light Railway in Staffordshire, Worcester Shrub Hill station and Pinnock Tunnel in Cornwall all get a mention in the text but are not pictured. The photos are also all recent ones, however, and having a selection of construction, period and interior shots would greatly lift the book.

An index would have been useful, and perhaps a table sorted by length across all tunnel genres. Finally the introduction to terminology could usefully have been expanded into a full chapter on tunnel construction showing illustrations of TBMs and other techniques in action. Hopefully, these omissions could be remedied in a future edition.

Despite these niggles, I can wholeheartedly recommend this book. If it had not been purchased for me as a gift, I would have bought it for myself. Once we are set free from lockdown, it will encourage me to seek out and explore those tunnels that are unfamiliar to me. This is a valuable addition to every Sub Brit member's library; with a bit more thought it could have been an invaluable one.

Underground Cities: mapping the tunnels, transits and networks underneath our feet

OVENDEN, Mark, 2020, Frances Lincoln, 224pp, [ISBN: 9781-7813-1893-5], £30



Book review by Martin Dixon

At a time when most travel – especially overseas – is forbidden during lockdown, it's some relief to be able to read about some of the world's great underground sites. Mark Ovenden's recent and ambitious book covers 32 cities across the globe and describes their key subterranean treasures. Many of the locations (eg London, Liverpool, Berlin and Gibraltar) will be well known to many Sub Brit members but others (such as Cincinnati and Mumbai) are less likely to have been visited first hand.

Selecting the 32 'winners' was obviously not straightforward and more than 50 'also rans' are helpfully, although briefly, listed; in truth not all of the latter are cities and many are known for a singular feature, such as Corsham or Naours. Mark himself is perhaps best known for his 2003 book *Metro Maps of the World* and underground railways feature strongly in his latest book too.

Site types mentioned include everything from the underground shopping centres of Toronto and Montreal to Cold War bunkers beneath Moscow and Helsinki. However the focus of the book is on transportation, especially metro systems. Some of the more unusual (and fascinating) sites, however, have only a sentence or two devoted to them which seems a little unbalanced.

Most cities have a clear double-page map devoted to them. These always show the metro system and the richness of other site types can appear secondary. In London, it is good to see some culverted rivers, the Post Office Railway and the Tower Subway on the map. The text for the Tower Subway however claims that it was built for pedestrians and converted to a cable-hauled railway when in fact the reverse is the case. It also states that it is now used for 'little more than water mains' when in fact these are also now disused and fibre for communications is the current after-use.

London's eight deep-level air-raid shelters are also mentioned in the text but only Clapham North shelter and Kingsway Telephone Exchange at Chancery Lane make it to the map. And Clapham North is described as hosting *Growing Underground*, which is in fact based in the Clapham Common shelter.

Although it is impractical to describe all sites in detail in the text, a map seems to be the ideal opportunity to maximise the coverage. Yet we get Brompton Road but not nearby Down Street as disused stations, Brunel's famous Thames Tunnel but not the adjacent Rotherhithe Tunnel. Only Piccadilly Circus and Hampstead are flagged as *Railway stations of note* amongst the dozens named on the map.

Where non-transport sites <u>are</u> featured, they often appear as a map-pin, including in Paris where hundreds of kilometres of the GRS (Grand Réseau Sud) are conflated into a single point. The text also misleadingly implies that one site (The Catacombs) is also the location of the

cataphiles' underground cinema and of a German air-raid shelter which are at quite separate locations.

In Budapest, the fascinating Kobanya Quarries are described but there is no mention of their use as a World War II aircraft factory or of their current role as a major site for sub-aqua enthusiasts. The 'mineshafts' are also described as in current use for mushroom cultivation. Pre-publication review of the book by a specialist would have corrected many of these anomalies, omissions and errors.

The book has some excellent photographs and also has a number of specially commissioned drawings by Robert Brandt. These drawings work well when used to produce cutaways but it's unclear to me why drawings have been made of sites where excellent current photographs exist. For example Williamson's Tunnels in Liverpool and Cathedral Steps in Manchester both receive this treatment. More successful is the use of a 'depth gauge' which indicates the relative depth of various cavities beneath each city.

But these criticisms are from an enthusiast and expert; in truth Sub Brit members are not the prime audience for the book. Anything that celebrates the amazing structures beneath our feet deserves our praise.

Covering the world in one volume was always going to be a challenge and there is much of interest within its pages. This is especially true for transport enthusiasts and for sites outside Europe where other volumes are less readily available. The ambitious scope of the book was never likely to provide a full banquet but the tasting menu that emerges left my own appetite somewhat unsated.

NEWS – TUNNELS AND TUNNELLING

Medieval tunnel system discovered by technicians in South Wales

A team working for Western Power Distribution made the discovery while moving an electrical pole near Tintern, in the Wye Valley, Monmouthshire. Western Power said the tunnels, near to 12th-century Tintern Abbey, were not shown on any Ordnance Survey map. and nothing had shown up on any of Western Power's drawings or records to indicate there was anything unusual about the site. After consultation with Cadw, the energy firm has stopped all work to allow archaeological investigation.

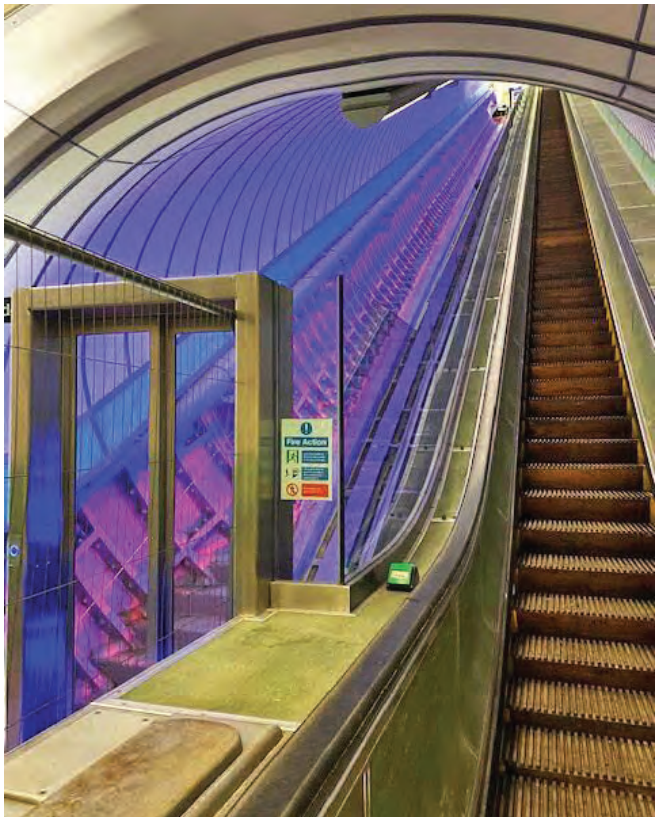
The 4ft-high tunnel was "tucked away" underneath a footpath running parallel to the Angiddy Brook, and appears to follow the brook's route along the valley. An expert from Cadw, the Welsh Government's historic and cultural heritage service, was said to be "very impressed" and "quite fascinated" by the discovery. It could take years to complete archaeological investigation at the site.

SOURCE: Western Power Distribution

Tyne tunnels have the longest wooden escalators in the world

Buried beneath the river bed of the River Tyne is a pair of pedestrian and cyclist tunnels that was built to provide a vital link between the communities on either side of the river. Access to these tunnels is via the longest wooden escalator in the world.

The Tyne Cyclist and Pedestrian Tunnels was an ambitious engineering project which involved miners operating in compressed air to excavate the tunnels. The project cost £833,000 to construct and was completed in 1951. The two tunnels run parallel, one for pedestrians and the other for cyclists. Both tunnels are 884 feet long and are 40 feet below the river bed at its deepest point. The cyclist tunnel has a greater diameter of 12 feet, the pedestrian tunnel is 10 feet in diameter.



This was Britain's first purpose-built cyclist tunnel, and it links to routes along the United Kingdom's National Cycling network. The tunnels were built to connect the Tyneside neighborhoods of Howdon (north of the River Tyne) and Jarrow (south of the River Tyne). The tunnels created a vital link for thousands of Tynesiders who worked in the shipyards and factories that at one time lined the banks of the river.

The escalators on site are still the originals, installed when the tunnels were first constructed in 1951. They are Waygood-Otis escalators and are composed of 306 wooden steps. When they were first installed, the steps were the highest single-rise escalators in the UK, with a vertical rise of 85 feet. They remain the longest set of wooden escalators in the world.

The tunnels are now Grade II listed and recently underwent a major restoration that cost around £16 million. The renovations involved closing the tunnels for six years. They reopened in August 2019.

During the refurbishment, two of the four original wooden escalators were removed and replaced with glass-enclosed inclined platform lifts. The remaining wooden escalators were left in place as emergency staircase exits, but are no longer operational. The side paneling of the wooden escalators has been removed to showcase the engineering. The internal workings of the escalators are now lit and visible from the adjacent platform lifts.

Walking or cycling through the tunnels is like taking a journey back in time to the 1950s. Along with the wooden escalators, many original 1950s features have been retained including the tiling which lines the interior of the tunnels. The old signage states the county boundaries as Northumberland and Durham. The county boundary line under the river is marked out at the half-way point along the tunnel. This is now the boundary of North Tyneside and South Tyneside.

The tiling and straight route of the tunnel result in some amazing acoustics, with conversations being heard along the length of the tunnel.

Parking is available on the south side at Jarrow; there is limited parking by the north entrance. Both entrances are a 15-minute walk from the Metro train stations. Free to use, the tunnels are currently open 24 hours.

SOURCE: Atlas Obscura

Man arrested trying to walk through the Channel Tunnel

In late December a 31-year-old man was caught attempting to walk through the Channel Tunnel. He was taken into custody by the French Authorities. He had been seen entering the tunnel and police teams on both sides were alerted.

Tunnel entrance in Folkestone

It is thought the incident cost Eurotunnel around £45,000 in lost revenue as trains had to stop for the search to be conducted.

SOURCE: *Kent Online*, 28 December 2020

Secret tunnels found in Poland baffle historians

Dating from mediaeval times, researchers have discovered two secret tunnels running underneath the Ducal Castle in the northern city of Szczecin in Poland. The surprising find was made in early February after expert cavers began exploring a network of Nazi-era passages that had been constructed during WWII.

Built in 1346, but copiously remodelled in the years after, the castle was formerly the seat of the Dukes that ruled the Duchy of Pomerania until 1637. In later years, Catherine Opalinska, the Queen of Poland, lived here, as too did the future Catherine II of Russia who was born and raised within the castle's walls.

Suffering 60 percent destruction during both Allied air raids and the Red Army's westward sweep, the castle was rebuilt between 1958 and 1980 primarily because of its significance to Polish and Slavic history.

In 2017 the castle again found itself flirting with trouble, this time after a pillar in the north wing collapsed and brought down a section of the ceiling. It was whilst investigating the cause of this accident that researchers deduced the presence of a German tunnel similar to the ones found across the city.

Together with ambitions to renovate the castle's terrace, this original reconnaissance spurred castle authorities to conduct a thorough examination of the entire hill. Commissioning a professional team of specialist cavers, a 16-metre deep vertical shaft was drilled into the castle's core before exploration could begin. When it did, the caving unit found the Nazi tunnel – which branched in different directions – in good condition. However, as they walked deeper they also discovered the prefabricated concrete giving way to a 25-metre stretch of vaulted brickwork. These bricks have now been authenticated as dating from medieval times.

Concerns have now been raised about the safety of the tunnels and just what else might lie below the surface.

These tunnels create a run-off for groundwater so urgent intervention is needed.

SOURCE: *The First News*, 17 February 2021

Friends of Greenwich and Woolwich Foot Tunnels wound up

Fogwoft was formed in September 2013 to promote the enjoyment of the Greenwich and Woolwich foot tunnels. The packed inaugural meeting specifically addressed the need for completion of the aborted refurbishment of the two tunnels and the reasons that work had seemingly ended.

Answers to both questions were given swiftly by Greenwich Council, the managers of the tunnels. Work recommenced, and was largely finished in later 2014. A report on the work was made public in October 2013 – the Wilmoth Report. Although a "grey-wash", that report did highlight major flaws in the whole contractual and management system. Both the Council and the supervisory Homes and Communities Agency were criticised. There should be lessons for the Council and other public bodies.

Both tunnels are used by well over 3,000 people a day. These are fairly equally divided between walkers and those with cycles. On the whole users continue the pattern set by people in the early 20th century. People go north to work; initially in the docks and ancillary trades on the north bank, now to banks and their ancillary business. People go south to have fun; in parks, museums, and "hospitality".

Opening of the Greenwich foot tunnel in 1902

Fogwoft celebrated its seventh birthday in September 2020. It should have held its seventh AGM by then but circumstances got in the way. The Committee, which has been reduced to three, now feels that many of its initial objectives can be assured without its agency.

Apart from Fogwoft's campaign activities it has celebrated the tunnels through social events (which partly raised funds for a non-subscription group), public talks, discussions (e.g. with Institution of Civil Engineers) and articles (such as that in *Subterranea*).

There has been discussion about using the entrances as space for small exhibitions – an idea which could be taken forward. It encouraged the Council to place interpretative plaques outside and inside the Greenwich tunnel.

The Fogwoft committee feels that it has achieved the feasible objectives set on its formation. Issues remain. But they are either political, or largely technical, in neither of which spheres can Fogwoft play a major role. It's been a full seven years but time to pass the baton to the community and to the relevant public agencies.

SOURCE: FOGWOFT press release, March 2021

Network Rail uses special train to remove icicles in tunnel

Network Rail has used a special train to remove dangerous 5ft icicles dangling from the roof of a tunnel on the Settle to Carlisle line.

The operator said some icicles were also cleared by hand by staff during the freezing weather conditions. Network Rail also has special winter trains, with hot-air blowers, steam jets, brushes and scrapers to clear snow and ice from the tracks.

Empty trains, known as ghost trains, often run overnight to keep the tracks clear. The icicles can fall and cause delays to passing trains.

SOURCE: *BBC News*, 12 February 2021

Search for Chichester's secret tunnels

Maureen Williams, 82, of Westgate, recalled a school trip into the rumoured tunnels under Chichester when she was at Chichester High School for Girls. She estimates she was in her early teens at the time and said she chose to share her memories after reading about the search for evidence in the local newspaper.

She said: "It was under the Crypt and right next to the cathedral. We had already seen parts of it and while we were down there our teacher was talking about Keats. It went along South Street."

Maureen described the tunnel as dark, and with a "black and brownish sort of colour". There's a story about Keats

having a coffee near the crypt and actually watching this priest emerge from the tunnels but he would have been in a room above the Buttery. Her story is intriguing because it ties in with the story about tunnels under South Street that run down the east side of the path, by Iceland.

SOURCE: *Chichester Observer,* 16 March 2021

Norway gives green light for world's first ship tunnel

Norway has given the green light to begin preparations for the construction of what is expected to become the world's first ship tunnel. The Stad Ship Tunnel will cut through the Norway's Stad peninsula allowing ships up to 25.5 meters wide to avoid one of the most dangerous routes along the Norwegian coast.

The Norwegian Coastal Administration has received an assignment letter from the Ministry of Transport and Communications, which gives a green light to start preparations for the construction of the tunnel. "Based on the allocation letter, we will now start the processes of acquisitioning properties in the area where the ship tunnel will be located, as well as put in place a project organisation, prepare a tender basis and initiate a tender," said Terje Andreassen, a temporary project manager for the Stad Ship Tunnel at the Norwegian Coastal Administration.

The entire project is estimated to cost NOK 2.8 billion (£238 million) with a construction period of three to four years. The Norwegian Coastal Administration is aiming to acquire the land and select a contractor sometime this year which will allow construction to start in 2022.

The Stad Ship Tunnel will be blasted through about a mile of rock at the narrowest point of the Stad Peninsula. The tunnel won't actually shorten the distance around the peninsula, rather it is intended to allow ships to bypass the Stadhavet Sea where the North and Norwegian seas meet, an area that is considered one of the most exposed and dangerous areas for vessels along the coast of Norway.

The idea for a bypass route through Stad has been kicked around in Norway for decades, but the idea has picked up steam in the recent years following studies pin-pointing the best route. Norway officially launched the project in 2017. If everything goes according to plan, the world's first full-scale ship tunnel will be completed in 2025/2026.

SOURCE: *Captain,* 18 March 2021

Campaigners in Islington dig protest tunnel

Environmental activists behind the anti-HS2 protest near Euston Station have opened up a new front by digging a tunnel in a bid to block the destruction of trees two miles away in Islington. Campaigners had been camped out at Highbury Corner for almost four months in protest at the felling of seven mature trees to make way for new flats at Dixon Clark Court.

After the council obtained a High Court eviction notice at the end of January, bailiffs and police launched a pre-dawn bid to evict more than a dozen campaigners. They attached themselves to trees but some managed to flee to a makeshift underground tunnel.

The underground network was said to have been "masterminded" by the same people behind the high-profile anti-HS2 campaign near Euston Station, where at least four people had been living in a 100ft tunnel for two weeks. They include veteran environmental campaigner Swampy, whose real name is Daniel Hooper, and his son Rory.

A spokesman for the Highbury Corner Tree Protection Camp said: "Although not strictly part of the campaign to stop HS2, the tunnel which forms part of the defences at the camp was masterminded by the same brains and shares many of the same features as the tunnel at the Euston Square Gardens Protection Camp." Protesters would not say how many were in the tunnel but added that they are "well provisioned with supplies."

Following the launch of the eviction operation at 5am, enforcement officers wearing special harnesses spent several hours removing protesters who had clamped themselves to branches before dismantling a makeshift treehouse. Islington council said it had earlier reached an agreement with Extinction Rebellion protesters who were on the site for them to leave.

The authority said the project would create 25 more council homes for local families and deliver 63 new trees across the borough, while creating an extra 100 square metres of communal garden space.

SOURCE: *Evening Standard* , 9 February 2021

London's Lost Cold War Controls

Steve Fox and Nick Catford

The Cheam Group Control in Church Hill Road in 1982. The Cheam Control, Pear Tree House and Kelvedon Hatch RGHQ were open to the public for a week. This coincided with CND's Hard Luck *campaign with protesters gathering outside the three facilities. Photo Mike Dodd*

In the late 1940s and early 1950s, Britain's civil defence planners expected the next war would follow the same basic pattern as the last. There would be widespread conventional air attacks on cities and from the 1950s some of these would include atomic bombs and chemical weapons. Plans were made accordingly.

In the late 1940s, a national survey was made of all available shelter space; plans for censorship and blackout were drawn up and millions of new civilian gas masks ordered. By the early 1950s, the assumption was that war would begin with an initial onslaught of atomic bombs after which both sides would recover and fight an extended 'broken backed' war with whatever resources could be scraped together.

Frightening forecasts

By 1955, plans were being made on the assumption that the UK would be hit by 132 atomic bombs targeted on seats of government, industry and population with London receiving 35 bombs. The planners based their calculations on what they called the "nominal bomb" with an explosive power or yield of 20 kilotons, roughly equivalent to those dropped on Japan. They predicted that these bombs would kill 1,680,000 people and injure another 957,000. Two-fifths of the country's houses would be wrecked and half of the manufacturing industry would be destroyed or damaged.

The Chislehurst sub-regional War Room in Kemnal Road in March 1996. The bunker was abandoned c1958 and was badly vandalised by this date. Photo Steve Fox

The loss of life, casualties and damage would be horrendous but based on experience from the Blitz and the attacks on German cities like Hamburg and Dresden the attacks would not result in the breakdown of society or the system of government. Consequently, civil defence

measures were only needed to help the survivors in the immediate "life saving" period to cope with the immediate and localised effects on the attack.

The Wanstead Group Control in Northumberland Avenue c1999. The building was demolished the following year. Photo Nick Catford

At the local level, the Civil Defence effort would need co-ordinating and the wartime regions were reinstated under the direction of a Regional Commissioner. The Regional Commissioners were now given purpose-built War Rooms which according to the 1949 Working Party would be "established outside the central key area of its Regional town; it must also be located in an area where adequate signal communications can be provided to keep the War Room in touch with other civil and military headquarters in the region… and with the Central War Room in London."

In practice, they were built at the sites of the regional civil defence centres from WWII:

Region		
1	Northern	Newcastle
2	North Eastern	Leeds
3	North Midland	Nottingham
4	Eastern	Cambridge
5	London	see below
6	Southern	Reading
7	South Western	Bristol
8	Wales	Cardiff
9	Midland	Birmingham
10	North Western	Manchester
11	Scotland	Kirknewton
12	South Eastern	Tunbridge Wells
Northern Ireland		Belfast

Under the original scheme London was to have its War Room at Ken Wood on Hampstead Heath. From there the Regional Commissioner would control the four zones that the city would be divided into.

During WWII, the London Region War Room had a large staff and this was expected to be repeated with the London Regional Commissioner having a staff of around 1,500 although only about 100 would be accommodated in the War Room.

The Mill Hill Group Control in Partingdale Lane in 2002. The building was taken out of use in 1958. By the late 1980s it was nominally designated as the North Group control although it was never re-equipped. Photo Nick Catford

London is divided

During the last war the boroughs of Greater London were divided pie-like into five sectors, three north and two south of the Thames. This division continued to be used for civil defence into the 1990s. With the re-emergence of civil defence in the early 1950s, four of the sectors were provided with war rooms originally known as 'sub-regional commissioner's offices'.

The operations room in the North East Group Control at Wanstead c1999. The control closed in 1993 but remained in good condition until demolition the following year. Photo Nick Catford

These four war rooms were identical, located at:

- Partingdale Lane, Mill Hill
- Northumberland Avenue, Wanstead
- Kemnal Manor, Chislehurst
- Church Hill Road, Cheam

These served (in order) the North, North East, South East and South West Civil Defence groups. A control for the North West Group was never built at that time.

The Tape Relay Room at South West Group Control in 1982 during a public open day. A row of Creed 7E teleprinters is seen. Every teleprinter machine is labelled according to its designated area: Wandsworth, Lambeth, Merton, Sutton, Richmond-upon-Thames and Kingston (being the sub-regions of South West Group), Q Met and two labelled UKWMO. Photo Stuart Vaughan

Although were no dormitories folding bunks were installed in one of the corridors at Wanstead operating on a 'hot bed' system. Photo Nick Catford

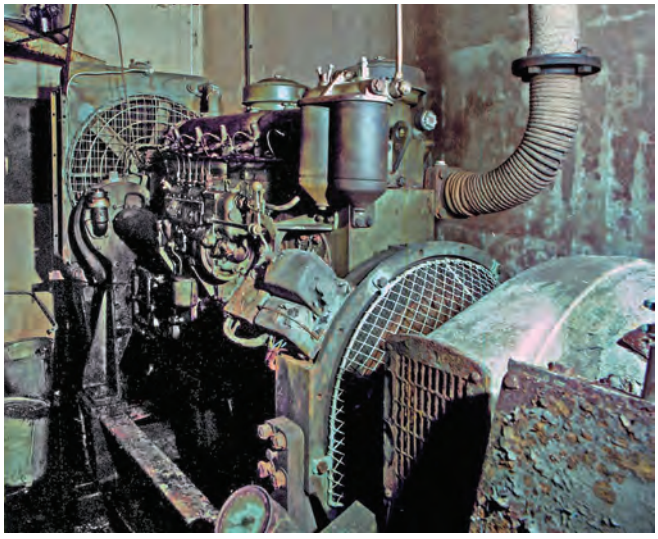
External view of the South East Group War Room at Chislehurst in 1998. No internal views of the building have come to light. Photo Ron Maxwell

The four war rooms were built to a common design in 1951-53 on the edge of the conurbation. They were single-storey surface blockhouses topped by three distinctive ventilator shafts. They were built around a central area which could be viewed from the controller's offices through glass screens. There was the usual back-up generator and air filters. A small canteen was provided but as in controls generally at this level there was minimal sleeping provision.

Operations room in the North Group War Room Mill Hill in 2002. Although unused since 1958 internally the building remained in good condition. Note one window on the left is openable to allow passage of documents, etc. Photo Nick Catford

Paddock may have been revived

There should have been a main London Region War Room. There is some evidence that Dollis Hill (Paddock) was nominated for this role although no evidence has come to light showing that it was ever equipped for such a purpose.



The standby generator at Mill Hill Group War Room in 2002. The generator has 1953 on the manufacturer's plate and has probably run for less than 100 hours. Photo Nick Catford

This fitted in with the idea about A-bomb warfare when the atomic bomb was really seen as a bigger conventional bomb and civil defence would only be needed for immediate aid to the bombed town. Then came the Strath Report (1955, declassified 2002) and the idea that the H-bomb would require the need for help on a much wider and longer basis. This gave rise to the plan for Regional Seats of Government (RSGs) from 1955.

It was thought that big urban areas would require an extra level of control between the local authority Civil Defence corps controls and the RSGs. This saw the introduction of the Sub-Regional Control (SRC). The scale of H-bomb destruction meant these had to be sited away from the centre of the sub-region.

The standby generator at Cheam Group War Room in 1982. Photo Stuart Vaughan

The four London Group areas were designated as sub-regions with nominal SRCs at Kelvedon Hatch (NE); Fort Bridgewoods, Chatham (SE); and Stoughton Barracks, Guildford (SW). North group was to continue to use the Mill Hill war room until the new bunker at Hertford was completed. In 1958 North group was divided and North West group established.

War Rooms become redundant

With the introduction of these sub-regional controls the four war rooms (except temporarily Mill Hill) no longer had a purpose. It is unclear if they were abandoned or mothballed at this time.

In 1963 the SRCs were redesignated as SRHQs with SE group being taken over by Dover. The other groups continued to be controlled from SRHQs at Guildford, Hertford and Kelvedon Hatch. In 1965 NW was transferred to Southern Region with its SRHQ at Warren Row (which was no longer needed as an RSG).

The SRHQs would cover a larger area than the earlier SRCs. It is unclear if the London boroughs were grouped for this with a group control standing between the borough control and the SRHQ. However, this was a period when there was very little spending on Civil Defence so it is possible that nothing was done. Whilst the war rooms/SRC/SRHQs would have been a Home Office responsibility, any Group Control would have been a GLC responsibility and seen as the equivalent of a county.

The Chislehurst war room had been abandoned by this time and its role was taken over by one of the oddest bunkers ever built. This occupied the bottom two floors (not underground) of a block of council flats at Pear Tree House, Lunham Road, SE19.

In the early 1960s the Metropolitan Borough of Lambeth was grouped with the neighbouring boroughs of Southwark and Camberwell to make up Civil Defence region 53a. Negotiations were taking place between them on a site for a control centre for the area and the then Conservative-leaning Lambeth Council was very keen.

Central Hill Estate. Pear Tree House stands on its own in the centre on the north side of Lunham Road.

Pear Tree House in November 1967, a year after it was completed. The bunker is housed in the windowless two lower floors. The main entrance is through a blast door in the middle of the lower floor. The emergency exit is through another blast door on the south side of the building on the upper floor

Housing estate bunker

A large area near Crystal Palace was designated for a new housing estate (Central Hill Estate) and as it was in the extreme south of the borough and well protected by the local hills, a site at the junction of Lunham Road and Hawke Road in SE19 was chosen. Whilst the two-storey bunker was being designed and approved the structures of civil defence and London government were changing.

Work on Pear Tree House started in 1963 but it was now merely going to be a borough control centre; the existing borough control in St Matthews Road, Brixton was to become a sub-control. The 18-room bunker and flats were completed in 1966 and the bunker went into care and maintenance when Civil Defence was stood down two years later.

In 1971 London was designated a region with its SRHQ (later RGHQ) at Kelvedon Hatch. Under this scheme of control a level of control (equivalent to a county emergency centre) would certainly be needed between the London boroughs and Kelvedon Hatch. In 1973 the

Greater London Council set up emergency planning teams looking at the future structures of Civil Defence in the capital.

It was decided that London would be split into five groups of boroughs, each having its own control centre and presumably the London Group Controls were introduced (or reintroduced) at that time.

In their last role as Group Controls or Emergency Centres they stood between the controls of the individual London boroughs and the RGHQ for London at Kelvedon Hatch; they would have performed a similar function in a post-strike regional government as a County Main Emergency Centre although unlike the counties they had no standby centre. Apparently, they were considered close enough to be mutually supporting.

They were administered by the London Fire and Civil Defence Authority (LFCDA) but as this, unlike County Councils, had no staff of its own the Group Control Staff including the Group Controller would have been provided by the borough councils within the group.

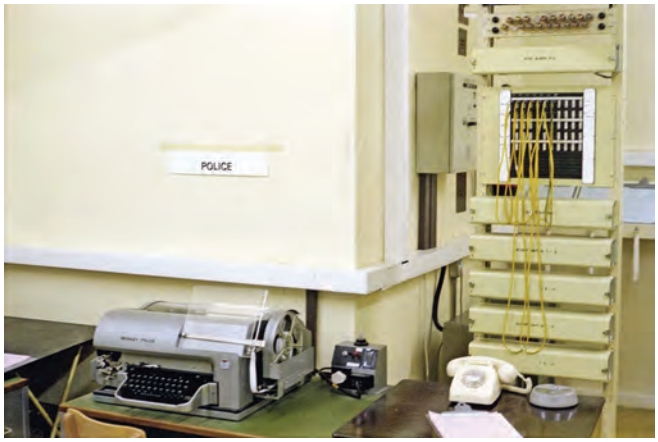
Campaign for Nuclear Disarmament on the scene

With Chislehurst now abandoned, GLC selected the Pear Tree House bunker as the South East Group Control and although not ideal it was converted for this use in 1979. Because of its location Pear Tree House received a lot of attention in the 1980s.

The 'L' shaped control room in Pear Tree House in January 2001.Various maps are still in place on the walls while papers litter the floor relating to the centres operation and exercises. On the left the entrance blast door is seen. Between the entrance and the control room the 4-room communications centre is on the left. Photo Nick Catford

It was a focus of local CND marches, its blast doors were fly-posted and it was open to the public for a week in 1982 for CND's *Hard Luck* campaign which coincided with the dates of the cancelled *Hard Rock* exercise. Speakers during that week included Duncan Campbell and Bruce Kent.

In the late 1980s the arrangement to rent the bunker from Lambeth expired and "nuclear-free" Lambeth threatened the London Fire and Civil Defence Authority with



Tape Relay Room at Pear Tree House in 1982. A Creed 7E teleprinter on the left communicated with the police. The unit on the right appears to be similar to the picture of the Southall Tape Relay Room on the front cover. Photo Stuart Vaughan

eviction. Another site was looked for but an agreement was made and it remained the SE group emergency centre until 1993.

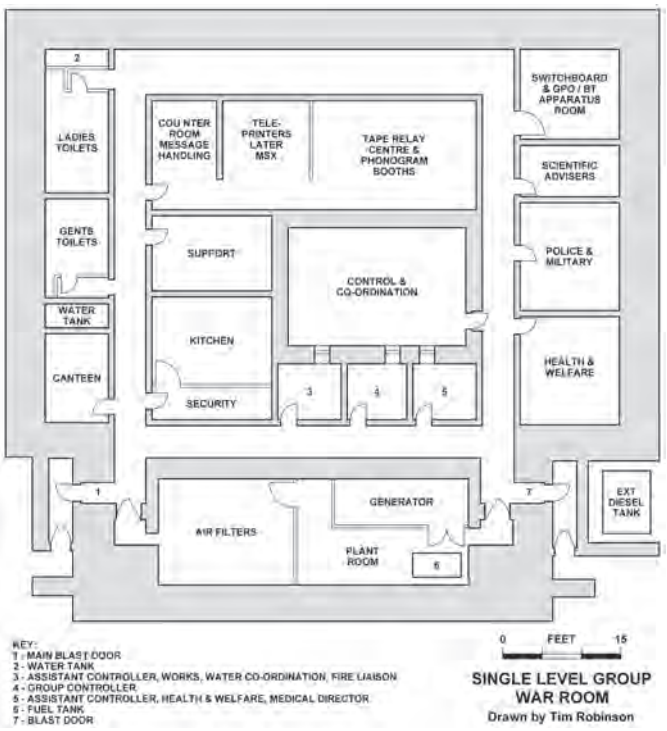
The wide corridor in the North West Group Control in 2001. Plant rooms are to the right. Note the three heavy safe doors on the left side of the corridor. The bunker started life as a basement for a new Southall Town Hall in 1938. The safe doors were the town hall vaults. The bunker has been flooded since Hambrough Primary School was built on top in 1983. Photo Nick Catford

The North West Group control was located in the basement of the new Southall town hall which was under construction in 1938, in South Road, Southall. The town hall was never completed and during WWII the basement was used as a civil defence group control and Southall borough control. It was enlarged and modernised for its new role in the 1970s. It also housed Ealing Council's emergency control centre.

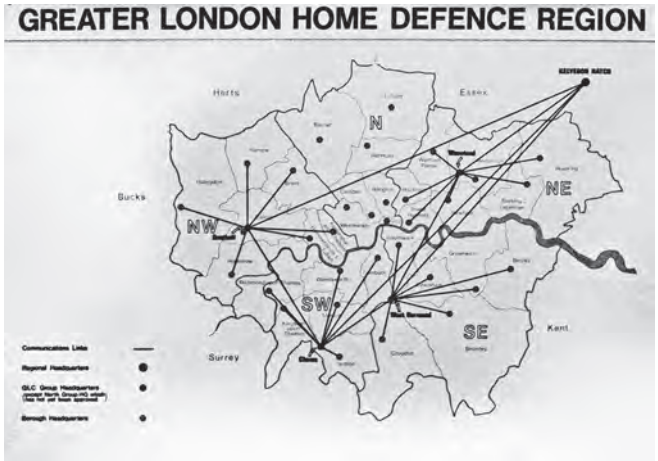
Mill Hill bunker is mothballed

By the time Civil Defence was revamped in the early 1980s only the Cheam, Wanstead and Pear Tree House controls were operational. From the evidence still visible below ground, the North West Group Control at Southall

Group Control	Desig-nation	Location	London boroughs
North	51A	Mill Hill	Barnet
			Haringey
			Islington
			City of London
			Westminster
			Camden
			Enfield
North East	51B	Wanstead Flats	Havering
			Barking & Dagenham
			Newham
			Tower Hamlets
			Hackney
			Waltham Forest
			Redbridge
South East	51C	Lunham Road, SE19	Greenwich
			Bexley
			Bromley
			Croydon
			Southwark
			Lewisham
South West	51D	Cheam	Wandsworth
			Lambeth
			Merton
			Sutton
			Kingston
			Richmond-upon-Thames
North West	51E	Southall	Ealing
			Brent
			Kensington & Chelsea
			Hammersmith
			Hounslow
			Harrow
			Hillingdon



Room layout of the original four group war rooms. All four were identical



This chart on the wall at Cheam Control shows only four of the five London groups had control centres; North Group having lost its control. This photo was taken in 1982 by which time North West Group had lost its control as well. Photo Stuart Vaughan

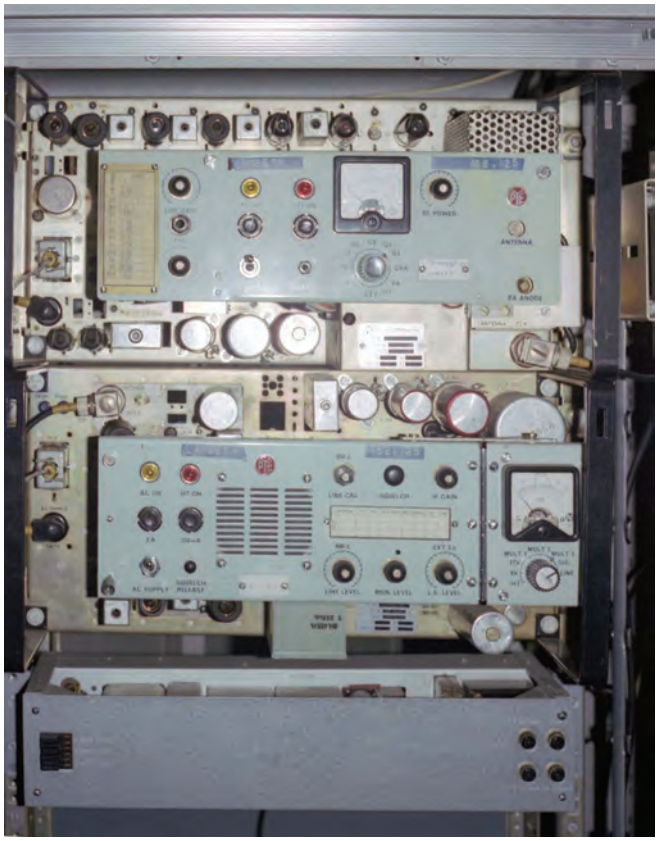
certainly took a part in the *Square Leg* home defence exercise in 1980 but there is no evidence that it was going to take place in *Hard Rock* two years later.

As Hambrough Primary School was built on top of the Southall bunker in 1983 it had definitely closed by that time. It seems likely that the erection of the school damaged the fabric of the building and may be responsible for the current water ingress although it was known to have a water problem while still operational.

A photo reproduced here of the Cheam War Room shows a map of the Greater London Home Defence Region. The photo was taken in 1982 when the bunker was open to the public during CND's *Hard Luck* campaign. The map only shows four group controls so it is clear that Mill Hill had already been abandoned by then and although still shown, Southall had also closed.

When the new message switching teleprinters were installed at the end of the decade, the equipment for the North and North West groups had to be installed at the LFCDA's headquarters to maintain the system's integrity as neither group had its own control by then.

By the late 1980s the Mill Hill war room was nominally designated as the North Group control although it was never re-equipped. Plans had also been drawn up to provide the North West Group with a control by converting the former Piccadilly line tube station at Brompton Road.



A Pye U450L UHF FM base station in Pear Tree House in 1982. This would have been used for two-way communications between Pear Tree House and Lambeth Council. The transmitter is at the top with the receiver below and the power supply at the bottom. Dymo labels on the unit state that the transmit frequency is 486.125 MHz and the receive frequency is 452.125 MHz. Photo Stuart Vaughan

It is possible that the intention was to use this as a centre for a general London-wide peacetime emergency in the spirit of 'Civil Protection' which by this time had all but replaced the term 'Civil Defence' but the plan was abandoned when the moratorium was placed on capital expenditure for Civil Defence. There is no sign that the controls were ever exercised although at least Wanstead was involved in exercise *Square Leg*.

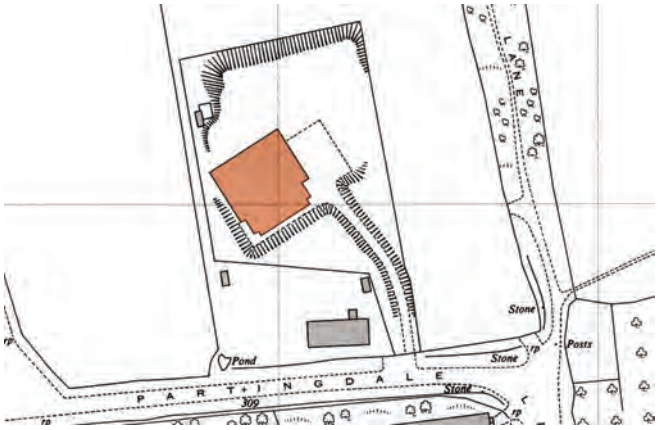
With the end of the Cold War in 1991 the remaining three group controls were redundant and closed in 1993.

The Group Controls today

North Group Control – Mill Hill

The building in Partingdale Lane was Grade II listed on 2 December 2002 and was described by English Heritage as:

> **Reinforced concrete construction**. Two-storey surface structure, with a central map room surrounded by control cabins, offices and plant room. Plain elevational treatment, with projecting parapet to flat roof and steel doors to entrance. Three protruding ventilation/exhaust structures on the roof of the bunker, arranged in line along the eastern edge of the roof, above the plant rooms. These are all box-like structures, perhaps 1.5m x 1m in plan and 1.5m tall, concrete or render, with black louvres in several faces.



Although not identified, the Mill Hill War Room is shown on the 1951 1:2,500 OS map.

Counter Room (message handling) in the Mill Hill War Room in 2002. Photo Nick Catford

Interior: The central planning room is surrounded by wooden framed windows connecting to the suite of surrounding rooms. These windows have fabric mesh instead of glass, and in each case one opening frame (to allow passage of documents, etc). All the surrounding rooms leading off the main corridor retain their original wooden doors, painted red (like the main entrance/blast doors) with white room numbers at eye level. The two entrances each have twin doors, a wooden (metal sheet reinforced) outer door with fairly normal locks and a substantial inner blast door set along each passage, fastened from within by two locking levels.

Most of the rooms retain original light fittings (single bulb fitments, covered by inverted glass domed cylinders) attached to original metal tube conduits for the wiring, metal light switch boxes etc. Most rooms also retain features such as metal coat hooks on wooden battens, and the original box-ducting for the ventilation system.

There are two lavatory/shower rooms, one male and one female. These are complete with shower stalls, hand basins, toilet cubicles and pedestals, and hot water tanks (twin sets of immersion heated tanks, each the size of a domestic hot water tank). Freshwater

Kitchen and canteen in the Mill Hill War Room in 2002. Photo Nick Catford

tanks (each made in rivetted painted metal steel, about 1.5m square) occupy the small rooms adjacent to each shower room, and there is one further water tank room on the southern corridor.

The oil-fired engine for the electrical plant is completely intact (1953 on the manufacturer's plate), together with the electrical plant itself (AC transformer, junction boxes, regulators, etc) mostly in the room alongside the power plant. In the adjacent room, the fan system for the internal ventilation appears substantially intact, together baffle/filter chamber and the main duct leading into the rest of the system (with summer/winter flow controls).

The Mill Hill War Room after conversion to a luxury residence in 2010 despite its Grade II listing. Photo Tony Murray

Despite this Grade II listing, the building was sold to a private developer for conversion into a five-bedroom luxury home called Seafield House. During the conversion a second floor was added and in 2010 the building was put on the market for £4,500,000. Eleven years later Seafield House is still on the market for sale at £10 million or rent at up to £10,000 per week.

North East Group Control - Wanstead

The NE Group War Room was demolished in 2000 and the site is now occupied by a nursing home. It was by far the best preserved of the four London war rooms at closure and should have been listed at that time.

South East Group War Room - Chislehurst

After closure of the war room in 1958 the site was abandoned and over the years was damaged by fire and

Although not identified, the Wanstead War Room is shown on the 1954 1:2,500 OS map.

The Kitchen and canteen in the Wanstead Group Control in 1999. Photo Nick Catford

vandals and became a playground for local children until it was bought by estate agents Piermont in 1998 whose plan was to convert it into a unique five-bedroom luxury home. In order to achieve this they employed specialists Son et Lumière to fit the converted bunker with the very latest in intelligent control and design.

Chislehurst Group War Room in 1998 during conversion into a luxury home. Photo Frank Wilson

Within two years the bunker in Kemnal Road was transformed into 'The Glass House'. Through the glass entranceway the immediate interior is not so much a hallway, but rather an atrium from which all rooms on the ground level lead off, and in the middle of which sits a swimming pool complete with a steel and glass staircase curving over it and leading to a new upper floor.

During the 1998 conversion a massive whole was cut in the roof for the new pitched glass roof. Photo Nick Catford

Directly over the pool and enveloping the centre of the property is an enormous pitched glass roof which gives the house its name. The roof can be opened using an electric motor. Windows have been cut into the 5ft thick walls, each window the result of three days' work by a two-tonne cutting machine.

Complete conversion of a bunker to a luxury house. Photo Amanda Chancel

The original asking price was £3,500,000. The luxury home remained unsold for many years despite a reduction in the price. Now The Glass House is still on the market and the asking price is still £3.5 million although offers are invited.

South East Group Control - Pear Tree House

After closure in 1993 the bunker was used as a social services store but remained empty for many years with Lambeth Council hoping a suitable tenant could be found. The exterior of the building was renovated towards the end of 2000. Despite this, the Council has been unable to find a use for this former control centre, the fact that it has no windows being a distinct disadvantage. They are still looking for a suitable tenant.

South West Control - Cheam

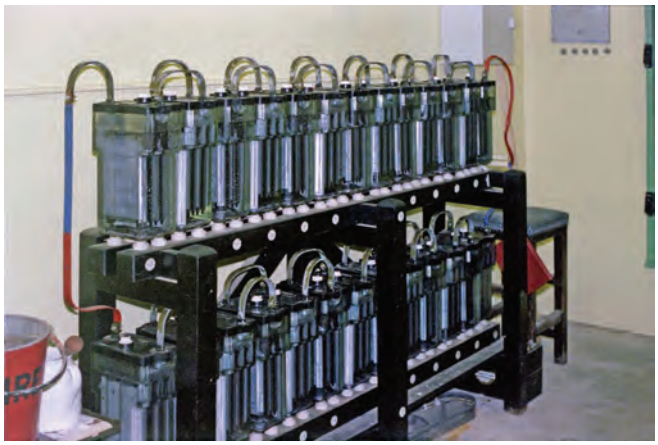
The South West control in Church Hill Road was demolished in the mid-1990s.

Side view of Pear Tree House in 2001 showing the main entrance to the bunker on the lower floor and the secondary entrance on the upper floor; both are heavy steel blast doors. The single storey block in the foreground houses electrical switchgear, ventilation plant and the standby generator. This is accessed from a door outside the bunker adjacent to the main entrance. Photo Nick Catford

Kitchen in Pear Tree House in 2001. Photo Nick Catford

North West Group Control -Southall

Today the interior of the bunker is in an appalling and dangerous condition. Everything is wet and most internal doors and partition walls have rotted away. At times the bunker has been partially flooded. The little paperwork that survives is sodden and virtually impossible to read. Much however still remains giving evidence of its former use. Rotting timber under water can give off hydrogen sulphide gas when disturbed, with its characteristic 'bad eggs' smell. Hydrogen sulphide is highly toxic and can be lethal and nobody should enter the bunker without being aware of the implications. Gas was detected in a number of the rooms during an inspection by members of Sub Brit in 2001.



Standby batteries in South West Group Control in 1982. They could be used in the event of a power failure. Photo Stuart Vaughan

Door into the Group Controller's Room at North West Group Control in October 2013. The door and partition wall have collapsed due to water ingress and condensation. Photo Nick Catford

Rear entrance into the North Group War Room at Mill Hill in 2002. Photo Nick Catford

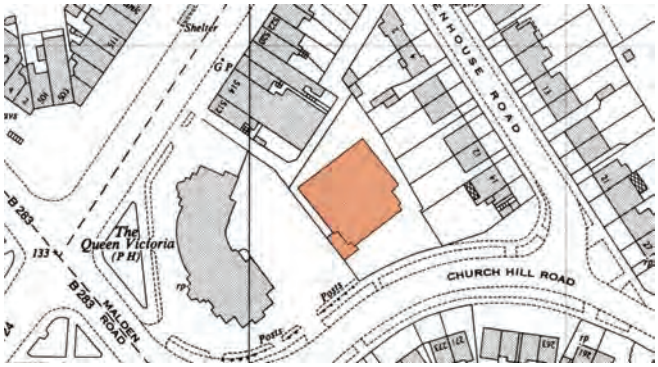
The 'L' shaped control room at South East Group Control, SE19. A map labelled Inter Region Map. Another map is seen through the doorway in the background. Photo Nick Catford

Phonogram booths in North East Group control c1999. Photo Nick Catford

Electrical switchgear room in the North Group War Room at Mill Hill in 2002. Photo Nick Catford

South East Group War Room in 1998, shortly after work started to convert the bunker into a luxury house. Photo Frank Wilson

South East Group Control SE19 in 1982. An array of DC power supplies used for powering teleprinter links are seen. This equipment was made by Ericsson Telephones Ltd at Beeston, probably in the early 1960s. Photo Stuart Vaughan



Although not identified, the Cheam War Room is shown on the 1954 1:2,500 OS map. It is the only one of the four original war rooms to be located in a residential area.

Construction date of the Cheam War Room. Photo Stuart Vaughan

A dog leg opens into a wide north-south corridor approximately 60 feet long. On one side of the corridor are the plant rooms where much of the ventilation plant, standby generator and a boiler are still in place. On the opposite side of the corridor there are three heavy man-sized 'safe' style doors. These were built as strongrooms for the unfinished new Southall Town Hall. In one of these rooms there are stocks of leaflets relating to flooding, a packet of GLC headed notepaper, some papers relating to exercise *Square Leg*, and a number of empty GLC War Emergency Plan files.

Control Room in the North West Group Control in 2001, the room is partially flooded and strewn with furniture. This is one of the rooms where Hydrogen Sulphide was detected. Photo Nick Catford

The Tape Relay Room at Southall in October 2013. Rows of Creed 7E Teleprinter cases are seen. The teleprinters have been removed from the cases. Much of the flood water was pumped out to allow this visit to take place. Photo Nick Catford

Some signage at Southall survives. This one says POLICE CONTROL and CO-ORDINATION Police & Fire Liaison. Photo Nick Catford

The Tape Relay Room still contains teleprinter tables along two sides with the teleprinter cases still in place, each sporting a GPO badge. Every teleprinter machine is labelled according to its designated area: Ealing, Hounslow, Hammersmith & Fulham, Harrow, Brent, Kensington & Chelsea, Hillingdon (being the sub-regions of North West Group), Q Met and two labelled UKWMO. There are also a number of chairs and a floor standing test jack and patching frame which includes a number of valve amplifiers with their valves still in place.

Another visit to the bunker took place in October 2013 when the London Borough of Ealing Architects Department invited Sub Brit to help reassess and interpret the structure, twelve years on from the previous visit.

The bunker was pumped clear of water for the occasion. In view of the hydrogen sulphide gas and asbestos noted in 2001, each visitor had to wear a regulation white Tyvek suit complete with hood and a FFP3 (filtering face-piece) mask. A full report of this visit with photographs and floor plan appeared in *Subterranea* 35 (April 2014).

To trash or to treasure: the cautionary case of the Ace High dishes

David Robertson

Drone view of the 4 Ace High dishes in July 2018, three months before demolition of two of them. Photo NW Scrappy

Recent events in our field of interest bring two well-worn sayings to mind. The first maintains that 'beauty is in the eye of the beholder'. In one sense, it's a statement of the obvious: we tend to assign value (historical and cultural as well as visual) to different things. My wife, for example, doesn't always see exploring concrete bunkers as the highlight of a holiday, and it's only fair to confess that one Chain Home receiver or transmitter block bears an uncanny resemblance to all the others we've visited over the years (as I suspect was the intention of their designer).

Stenigot Ace High dishes before closure of the station in January 1992

The question of whether beauty is or isn't subjective has been debated at least since the days of ancient Greece,

while in *Love's Labour Lost* Shakespeare observes that 'beauty is bought by judgement of the eye'. In its current form, the phrase first appeared in Margaret Wolfe Hungerford's 1878 novel *Molly Bawn*.

My second aphorism is equally ancient. 'Ful ofte in game a sooth I have herd saye' writes Geoffrey Chaucer in the Prologue to *The Cook's Tale*. The modern equivalent is 'many a true word is spoken in jest' and, taken together, these two phrases confirm that defining 'beauty' is a complicated matter.

As long as I don't push my luck, my wife and I have so far managed our differing priorities. And we don't always disagree; we both thought the highlight of a week in Kent was our trip on former Thames sailing barge *Greta* around the mysterious Maunsell Forts which defended the gateway to London during World War II and were later home to a pirate radio station, while even she was fascinated by the giant sound locators at Dungeness.

Planning and Protection

The debate can have more serious implications, however, as when the owners of a precipitous parcel of land in our part of Malvern sought permission for what they (and I) saw as an exciting use of a difficult site but others thought too modern to fit in with its largely traditional neighbours. The radical side won and the house appeared on *Grand Designs*.

Stenigot *Ace High tropospheric scatter radio station before closure in January 1992*

On this occasion the risk of unpleasantness was largely avoided by delegating the decision to professionals – in this instance the planning officers of Worcestershire Council. Something similar happens when disagreements arise over our existing, rather than our future, built landscape. The professionals in such matters are the expert staff of Historic England (formerly English Heritage) who must decide whether buildings are important enough to deserve legal protection.

At the highest level are around 20,000 Scheduled Monuments. Below them sit some 400,000 structures 'listed' as Grade I, Grade II* and Grade II while several local authorities maintain their own record of valued buildings. Demolishing or damaging properties on these lists can carry penalties of varying severity.

If the planning and protection systems *sound* similar, the devil is, as so often, in the detail. Council officers can, if necessary, order the destruction of a building put up without approval. By contrast, historic structures – save for those near the top of the priority list – are less well safeguarded both legally and practically than many people (including, I suspect, Historic England) might wish. It makes little sense to require the rebuilding of an ancient structure; and while in theory someone who breaks the rules can be fined or even imprisoned, this rarely happens.

The organisation has fewer staff and smaller budgets than the planning system taken as a whole and its limited funds have been cut by successive governments. Many worthy candidates do not get listed because case officers are overloaded, the building in question isn't quite rare enough or isn't perceived as being at risk and for many other reasons.

Stenigot *Ace High tropospheric scatter radio station before closure in January 1992*

All of which brings us to the 'events' alluded to above. If my wife enjoyed our day out in the Thames estuary, she and our youngest daughter were equally intrigued by another side trip, this time en route to Yorkshire.

The focus was the site at RAF Stenigot, near Louth in Lincolnshire, which then housed artefacts from two separate eras in defence history. The first, which I'd come to film for a project based on interviews with radar pioneers including Bernard Lovell and Edward Fennessy, was one of the relatively few Chain Home towers on its wartime site and in more or less its original condition. What fascinated all three of us even more, however, were four massive parabolic dishes nearby.

Dish of the Day

These metal dishes turned out to be far rarer, for they were among the few surviving artefacts from the *Ace High* NATO microwave communication network dating from the 1960s. Briefly, the dishes were part of a network that conveyed information securely between NATO member countries by reflecting high-intensity radio signals off the troposphere five to ten miles above the earth.

These signals were picked up by sensitive receivers and beamed onward to the next in a chain of 82 stations between 50 and 250 miles apart that stretched from northern Norway to eastern Turkey. Two of the Stenigot dishes pointed north to pass messages to and from the relay station near Alnwick, Northumberland, whilst the other pair was aimed towards a station at Maidstone in Kent.

Map showing the extent of the Ace High system, taken from an STC advertisement of 1961

The two other UK stations were on the Shetland Islands and in Aberdeenshire. To generate waves of sufficient power, the dishes needed to be far bigger than those associated with modern microwave links and were up to 60 ft (18 m) in diameter.

When the system was introduced in 1959, officers at RAF Stenigot who had provided early warning of raids from German Luftwaffe bombers during WWII found themselves relaying information about the risk of attack from Soviet forces. The site remained in operation for more than thirty years but advances in communication technology during the 1980s made the system redundant and it was discontinued in the early 1990s.

Only five Ace High stations

While there were eventually more than fifty Chain Home and Chain Home Low radar installations around the UK, there were never more than the five Ace High stations. Ironically, however, although the RAF Stenigot Chain Home (CH) transmitter tower and transmitter block were *both* listed in 1997 (at Grade II* and Grade II respectively), the Ace High structures were given no statutory protection at all.

Coldblow Ace High radio station in Kent, one of only 5 Ace High stations in the UK. Photo Andy Emmerson

Due to their rarity, and to their spectacular size, the massive Stenigot dishes became popular with professional and amateur historians and the wider public with the result that dozens of photographs and videos can be found on British and foreign websites. I imagine these images encouraged more and more people to visit the site, which lies within an active farm, and suspect this fact might have some bearing on its eventual fate.

In October 2018 people hoping to see the dishes discovered that three of them had disappeared. *Lincolnshire Live* journalist Peter Hennessy said an urgent investigation by East Lindsey District Council, prompted by their location on a historic site, revealed that they had been removed and destroyed by local construction firm JE Spence and Son, evidently at the request of the site owner.

The four parabolic dish antennas lying on the ground in 1998. Photo Nick Catford

A Spence employee told the newspaper 'they have been chopped up and sent to a scrapyard [and] I'm guessing they'll be melted down.' My photograph shows the four dishes as they were in 2014 while a Google Earth image dated October 2019 reveals that by then only one was still in place.

Now you see it.....

Late last year, rumours began to circulate that the fourth and last dish had now also gone – something technology and military history enthusiasts found upsetting not least because relics from the Cold War tend to be less well understood, less well documented and, sadly, less well protected than those associated with WWII.

This total loss has since been confirmed. What no one seemed to know was who ordered the demolition and why. I am now able to answer that question, and my suspicion that the dishes' popularity was part of their undoing proved to be correct.

The area in question is just a small part of the much larger Stenigot Estate which includes an organic farm and several residential and other properties. The estate is owned by David Dennis and before Christmas I wrote to ask if he could tell me what had happened. His response is clear and exhibits, as far I can deduce, neither

embarrassment nor regret. He had, he tells me, extended the existence of the dishes for twenty years but decided to remove them for the sake of what he calls 'peace and quiet' as they were a cause of 'disturbance to the tranquillity of the area'.

Demolition is underway in October 2013. Photo from Lincolnshire Live

Dennis has decided to plant the area with trees, creating a small woodland that he hopes will enhance its position on the ridge of the Lincolnshire Wolds as an important route for migrating birds. This was not, he acknowledges, the response I had been hoping for but, to add to my tally of aphorisms, he suggests there may have been clash of values and that in such circumstances it is not always possible to make an omelette without breaking eggs.

Pictures available online, together with a large amount of graffiti on the dishes, suggest that these relics had indeed become a meeting place for young people – many of whom, it's fair to assume, did not come from the village or its immediate surroundings. While it's hard to know whether damage was done to the objects, it's obvious that not all visitors behaved well, respected the Country Code or were considerate of the local community.

It is also clear that some people didn't just *visit* the dishes but climbed on them too. Though they'd long been detached from their huge metal legs and were now lying on their sides, these were nonetheless huge objects whose top edges would have been many metres above the ground.

The one surviving Ace High dish at Stenigot *in October 2018. Photo by Richard Hardesty*

If someone had been hurt, responsibility could ultimately lie with the Stenigot Estate (the law says that landowners can be sued for injury, even injury to trespassers, if there is 'any risk of their suffering injury on the premises by reason of any danger due to the state of the premises or to things done or omitted to be done on them').

Drone view of Ace High dishes in July 2018, three months before closure. Photo by NW Scrappy

More Questions than Answers

The fact that some visitors behaved discourteously and perhaps dangerously makes it hard not to sympathise with the position in which David Dennis found himself and to understand – if not to welcome – the decision he's taken in response. The 'beholder' in this instance did not judge the objects in question 'beautiful' enough to justify the cost of maintaining them.

All that said, several questions arise, many of which relate not only to the Stenigot dishes but to the wider question of how historic objects on private land are preserved and protected. For example:

* Does the owner of a site like this one necessarily also own any buildings or objects contained on it? In this case, we'd need to know under what terms the RAF acquired the land before WWII, and whether the legal situation changed when the Ace High structures were built and eventually decommissioned.

* Why were the Ace High dishes not protected in law when the Chain Home mast and associated buildings were listed at Grade II and Grade II*?

* If they *had* been listed, would that necessarily have saved them? A report by the heritage department of Lincolnshire County Council says that, despite its also being listed in 1997, the CH Receiver Block was nonetheless demolished a few years later.

* Why was the Ace High site not better protected? The report cited above says 'the facility was built within its own fenced compound inside the former Chain Home radar station [and] surrounded by floodlights'. What happened to these defences?

* Was the possible demolition of the Ace High dishes discussed in advance with Historic England, Lincolnshire

The Stenigot *Ace High dishes and the adjacent WWIII Chain Home radar receiver block in 2003. The building was listed by Lincolnshire County Council in 1997 but demolished a few years later. Photo Nick Catford*

County Council, East Lindsey District Council or any other public body and, if so, did they give their approval?

* Were the dishes offered to any heritage body and/or did any organisation offer to take responsibility for their security?

I cannot complete the article since any conclusions will necessarily be influenced by the responses – if any – of the site owner and relevant public bodies to these questions. I am, however, drawn back to the visits I've described above.

My wife and I went to two sites; both were in relatively good condition given their age. I suspect it's no coincidence that one site was far out to sea and could only be reached by boat. The other (the sound mirrors) is now located on a man-made island in a gravel quarry. Obviously one could swim over to them, but I suspect most would-be vandals wouldn't bother.

The point of the story is that if we're going to protect our heritage, we have to be willing to invest time, money and imagination into doing so. Realistically that's never going to happen to every valuable site and hard choices are inevitable.

Dolomite, Ironstone and Non-Ferrous Mines in Luxembourg

P.W. Sowan

Luxembourg's considerable iron and steel industry has resulted in a number of underground mineral workings in this small country. There are good ironstone resources, although all coal used has had to be imported from neighbouring countries. Dolomite, for refractory furnace linings, has been mined.

Ironstone

Ironstone has been reported to be worked opencast, and from drift-mines and shafts. In 1944 driving of drift-galleries was the method most widely employed.

At different levels along the 'minette' escarpment and on the slopes of the valleys cut by the streams, numerous tunnel-openings are to be seen. These mark the entrances to systems of galleries which are planned to follow the various ore beds. Some are roughly hewn, while others, especially the large ones, are more elaborate. Passing into these tunnels and disappearing into the darkness can be seen a railway track, a footpath and overhead cables for power and light. Where possible, two or more beds are worked in the same gallery, and as a rule a roof of two or three yards in thickness is adequate to ensure the safety of the miners. The ore is first dislodged by an explosive charge and then broken up by the miners with pneumatic drills and hammers. Serious accidents are infrequent, although they do occur. In January 1933, for instance, six miners were buried by the collapse of a roof in the Fond de Gras mine. Shaft-mining is found at only two places in Luxembourg, at Ellergrund and Hoehl.

The Naval Intelligence Division's Geographical Handbook has a photograph of a drift-mine entrance near Differdange. Twenty-one mines are reported to have been exclusively underground. The iron ore field, a continuation of that of Loraine, is restricted to the southernmost part of the country, in the neighbourhood of Esch-s-Alz, Dudelange, and Bettembourg.

Dolomite

Dolomite has been mined underground by pillar-and-stall methods in the neighbourhood of Wasserbillig, near the German border in the extreme east of the country. It was used for the manufacture of refractory linings for basic steel converters. A photograph of the interior of the Wasserbillig mine can be found in the Geographical Handbook.

Non-ferrous ores

Antimony, copper, and lead ores have been found in Luxembourg. Antimony is said to have been mined until 1745, with unsuccessful attempts to revive the industry for a few years from 1847. A copper mine was worked from time to time since the 17th century at Stolzembourg. Lead ores were worked on the Belgian border between Allerborn and Oberwampach, discovered in 1787 and worked for at least 40 years from 1826.

References

UK (Naval Intelligence Division), 1944, *Luxembourg*. B.R. 528 (Restricted) Geographical Handbook Series.

Tura Caves – Egypt's source of Limestone

Adrian Armishaw

View of the wadi from the northeast

I first became aware of the Tura Caves through reading *The Royal Air Force Builds for War, a History of Design and Construction in the RAF 1939–1945*, originally published as 'Works' by the Air Historical Branch in 1956. It describes a very large underground complex which was constructed in the Tura and Massara Caves in the Mokattam Hills, a few miles south of Cairo.

View of the wadi from the northwest

The caves were the source of the fine limestone which was used in antiquity to clad the famous pyramids at Giza. This produced galleries excavated into the hills which were between 40 ft and 80 ft wide and from 25 ft to 40 ft high. Many of the galleries had cartouches carved into the walls by the masons. Huge quantities of waste stone almost filled many of them, and this was gradually removed and used to build access ramps and roadways up to the entrances which were a considerable height above ground level.

World War II

Tura caves became of great use to British forces in the Second World War. A small number of caves had been prepared for occupation in early 1941, but after Rommel's advance to El Alamein and several bombing attacks on No.102 MU at Abu Subir, which was at the time the RAF's major equipment holding unit in Egypt, it was decided to greatly expand the area and range of stores. Areas were set aside for the Command main base holding of bombs and explosives, MT, equipment and aircraft stores including engine and propeller repair sections. Later a radar workshop and underground hospital were added.

Accommodation - No. 111 MU

Cave No.	Group or Section		Area/sq.ft.
5	C	Bulk M.T.	12,430
8C	Y	Aero Engines	16,320
10	-	-	5,140
13	R	Radio	2,300
14	K	Bulk Tyres	2,900
17	P	Parachutes & Safety Equipment	15,100
18	K	Bulk Tyres	11,000
19	C	M.T. Bulk	12,780
20	C	American M.T.	30,100
21	C	Marine craft & Gen. Sets British M.T.	62,850
22	H	Paints	2,360
23A	K	Tyres	34,100
23B	R	Radio	38,000
23C	F.G	Instruments & Electrical Armament	43,400
24A	A.B	Ground Equipment	35,200
24B	D	Photographic	24,400
25	R.I.M.U.		14,600
26A-F	E	Aero Engine Spares	40,630
26G.H.I	3 E.R.S.		49,150
26I	G.E.S.		3,800
26J	R.I.M.U.		19,600
26K.L	P.R.S.		29,400
26M	2 E.R.S.		18,600
26N	S.R.S.		14,800
26 'Cathedral'	D	Photo. Bulk	24,600
26 'Cathedral'	Y	Aero Engines & Propellers	71,570
26 'Cathedral'	Plating		6,400

Equipment	**485,180**
Technical	**156,350**
Total	**641,530**

Other caves in the area were used for similar purposes by the Army, but that falls beyond the scope of this article. Further caves were also being used by Egyptian Government departments, the Department of Antiquities and Cairo Museum.

Using a brief gap between lockdowns, I was able to visit the National Archives at Kew where I had located references to the site. I was surprised to find not only two files of photographs, but also a detailed unit history which had been prepared for the Air Historical Branch before the site had been handed back to the Egyptians.

I am greatly indebted to the anonymous author of the historical account which is reproduced below.

Royal Air Force Operations Record Book No. 111 MU
August 1941 – March 1947

Foreword

No. 111 Maintenance Unit was formed in the caves at Tura, 14 miles south of Cairo, in August 1941. The unit is unique in that it not only accommodates a large quantity of RAF equipment of all kinds, but it also contains workshops for the overhaul of aircraft engines, propellers, signals equipment and other items. As, under the existing terms of the Anglo-Egyptian Treaty, the unit is liable to be moved from Tura, and as existing documents do not provide a record of the unit which is by any means complete, it has been thought desirable to compile this historical record.

Acknowledgements are due to Dr O.H. Little, Director Geological Survey, for the material from which the first section is compiled; to Dr A. Lucas, Department of Antiquities, for permission to quote extensively from his book *Ancient Egyptian Materials and Industries* (2nd ed.) in compiling the second section, and to a few officers and men of the RAF still remaining in these parts who have been able to contribute from their personal knowledge of the unit's history.

Geological origin

The eastern boundary of the Nile valley between Helwan and Tura is formed by the cliffs of the Gebel Hof and Gebel Tura. In the desert between the cultivation and the gebel there are the remains of ancient terraces of the Nile, which in places have been covered by downwash from the neighbouring hills, and on the higher part of the desert between Helwan and Ma'adi a number of Paleolithic and Neolithic sites have been found. The foot of the cliffs is about four kilometres from the Nile at Gebel Hof, but approaches to within two kilometres of it at Gebel Tura.

The cliffs rise steeply to about 200 metres above sea level at Gebel Hof, but fall to 150 metres at Gebel Tura. The plateau behind rises from the edge of the cliff inwards towards the east and attains a height of 300 metres at a few points. For a distance of over 10 kilometres along the cliff face numerous entrances to galleries can be seen from a distance and from these galleries the Ancient Egyptians extracted large blocks of stone for building purposes. These workings are generally known as El Ma'sara quarries from the village of that name between Helwan and Tura.

Stone was still being quarried during Ptolemaic and Roman times. The ramifications of the galleries are immense, and over 20 kilometres of them have been mapped. They follow the nearly horizontal beds of massive limestone in the upper part of the 'Building Stone Series' at the top of the middle Eocene, which are renowned as an excellent building stone.

Near the base of the cliff these beds contain some sea urchins and in the beds higher up there are internal casts of bivalves. The large nummulite, *Nummulites Gizehensis*, abundant in the 'Lower Building Stone Series', has been replaced by a smaller one, and sections of these fossils can be seen in the blocks which have been quarried. The top beds which form the plateau are hard limestones of the Upper Eocene age, and contain numerous Bryozoa.

A number of the entrances are about 90 metres above sea level, and the thickness of the overhead cover varies between 80 and 100 metres. Many of the galleries are 10 to 12 metres wide and 10 to 12 metres high, but near the entrances where the stone between a number of galleries has been cut away there are unsupported spans up to 45 metres across. The limestone is much cut up by joints and small faults, and a large part of the flat roof of the galleries has fallen down, possibly the result of earthquakes.

In some of the smaller caves the method employed by the ancients for extracting the stone can be seen clearly. The rock was removed in steps from the top downwards. When the top step had been removed a groove 20 to 25 cms wide was cut along each side of the gallery from roof to floor and the rock in the middle removed in slabs. The slabs were freed by drilling along the bottom edge and inserting wooden wedges which were then wetted. They were then removed on rollers.

A causeway 1.5 miles in length extending from the mouth of the Wadi Tura to the present bed of the river Nile, down which stones were evidently moved, can still be clearly traced. The causeway is eight metres wide, with the roadway width five metres; traces of rough masonry work appear in it and at its greatest height it is 15 metres above the normal ground level.

Ancient history

Although limestone was generally quarried in the immediate vicinity of where it was required, the better qualities were obtained from special localities, and such quarries are often referred to in the ancient records, for example, those at Tura, which may be seen today with the ancient inscriptions on the walls.

At Tura the inscriptions date from the Twelfth Dynasty to the Thirteenth Dynasty (1985–1788 BC), but there are references on the monuments to the Tura quarries as early as the Fourth Dynasty (2610–2498 BC), and the stone was employed extensively at Saqqara from the Third Dynasty (2680–2610 BC), and at Giza from the Fourth Dynasty. The quarries are still (1934), being worked on a large scale.

The casing stones of the two larger pyramids (of Giza), those of Cheops and Chephren, and the casing stone of the upper portion of the third pyramid, that of Mycerinus, although of limestone, was of a different and much finer-grained quality than the rest of the stones and free from fossils, as may be seen from the few blocks that remain, and, as this stone does not occur in the immediate neighbourhood, it must have been brought from

elsewhere and almost certainly from the Tura quarries on the opposite side of the river; and the statements of Herodotus, Diodorus, Strabo and Pliny that the stone for the construction of the pyramids was brought across the river from quarries in the Arabian Hills is true only of that for the casing.

At this time, however, the casing of the first and second pyramids was intact and all that could be seen was the Tura stone on the outside and there would have been no indication that the stone underneath was different. The step pyramid of Saqqara, too, is built of stone quarried on the spot and was cased with a better quality of stone, probably also from Tura.

Early RAF history

In December 1940 the caves in the Wadi at Tura were surveyed by some RAF officers, and the Department of Antiquities was approached with a view to taking over Nos. 23 and 24 caves for storage of explosives to form a sub-depot of No.101 MU which was already established in the Massara caves.

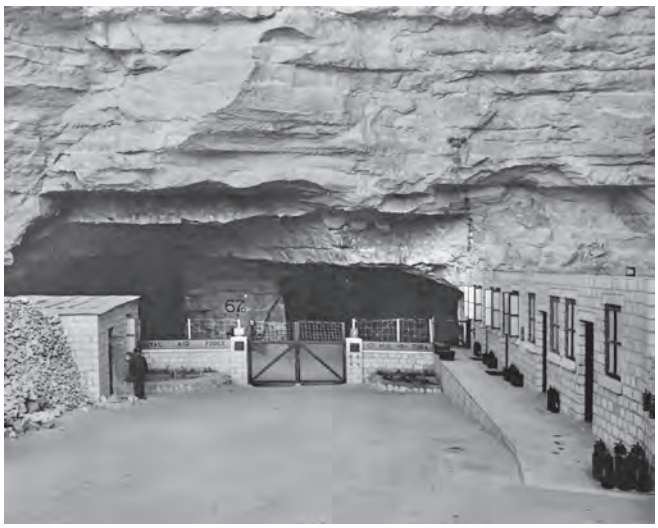
This policy was approved in January 1941 and the Works Directorate started making roads. By March the sub-depot was in existence, and in the following month it expanded into caves 21 and 22. The war then took a hand in affairs. After Wavell's advance into Cyrenaica in the winter of 1940 the enemy returned to the gates of Egypt in the spring of 1941 and stood there until Rommel's advance to El Alamein in June 1942; here he was held until the finally victorious British advance following the battle of El Alamein October 23 – November 2, 1942.

Underground ammunition storage used by No.101 M.U

It was in the shadow of these events that No.111 MU was born. During July 1941 the enemy bombed No.102 MU at Abu Subir a number of times, culminating in a particularly heavy attack towards the end of the month. This unit was at that time the one major equipment holding unit in Egypt and was no doubt singled out for attention on that account.

Between 13–21 August a number of officers from H.Q., RAF, Middle East, including Air Vice-Marshal Dawson and Air Commodore Boswell, visited No.101 MU to inspect caves which it was stated were required for a Universal Equipment Holding Unit, and specific mention was made of M.T. spares and an ERS (Engine Repair Section).

Returns section of No.101 M.U.



Entrance guardhouse to one of No.101M.U's caves

Action was not long delayed, for on 24 August Squadron Leader Boston and nine other ranks arrived on attachment to No.101 MU for the formation of No.111 MU, and two junior officers arrived the following day. The airmen had come from No.102 MU and simultaneously there arrived 35 rail truckloads of equipment from that unit in the Cement Company's sidings at Tura El Asmant station.

Five lorries were borrowed from Helwan. Three drivers were found among the airmen who had arrived, one was borrowed from No.101 MU, and, with one of the junior officers himself driving the remaining lorry, unloading was commenced. The equipment received was mostly M.T. spares, but was in hopeless confusion just as it had been picked out from among the debris at Abu Sueir.

The first caves occupied by No.111 MU were Nos. 20 and 21, which had been cleared of rubble for the use of No.101 MU and were as yet only partly occupied by them. The first office consisted of an area at the cave entrance screened off with hessian. Cave 24 was the next to be occupied as No.101 MU moved out. An oil dump was sited in the open desert near the rail siding.

Underground bomb storage

Underground bulk flare storage

Airmen at first lived under canvas at No.101 MU and officers lived out in Maadi. In mid-September however a tented camp on the site of the present Barrack Stores compound was opened up and occupied by the officers, NCOs and men who now totalled about thirty.

Bulk ammunition storage

In October 1941 Headquarters No.206 Group projected the establishment of No.111 MU in two echelons to control the dispersed sections in the Tura and Bulac areas, and Wing Commander G.R. O'Sullivan was appointed to command. He collected together Headquarters personnel at Helwan and organised the preparation of a new camp site at Tura to which he moved on 16 November. In the new camp were accommodated the personnel of an ERS party at Massara Cement Works.

Underground bomb storage

No,1 Radar Installation and Maintenance Unit moved an advance party of 46 men to Tura from Aboukir on 5 November, and the rear party on November 28. They occupied office and workshop accommodation in Caves 26A and J, where they have remained ever since, and were settled and ready to work by December 1 1941.

This unit was absorbed into No.111 MU establishment on its formation, but subsequently, on March 12 1942, broke away and became a lodger unit. No.1 R.I. & MU was finally disbanded on May 1 1945.

Bulk ammunition storage

Loading ammunition from the repair and repack section

Entrance to Smoke and Incendiary Weapons store

Bulk storage of Smoke and Incendiary weapons

Subsequent RAF history

The unit has grown up to be known universally as 'Treble One MU' and the only change in its existence has been the breakaway of 'B' Echelon to form an independent unit – No.109 MU – on April 1 1943. This history will therefore deal only with that part of the unit located at Tura.

The caves

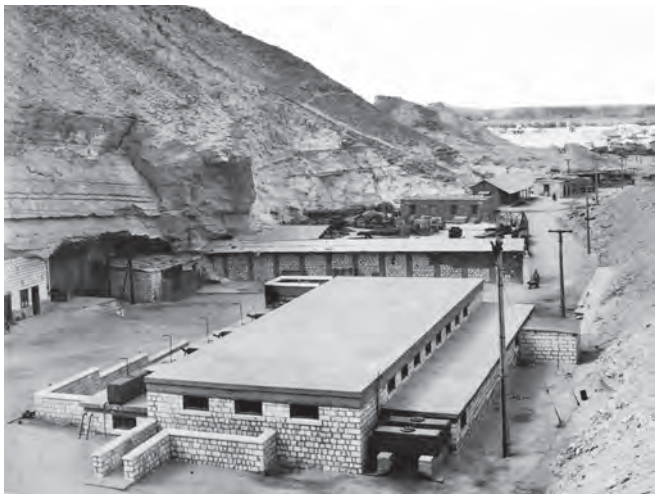
The caves area continued to be opened up, and by August 1942 the cementing of their floors was reported complete except for a few small details. Roads were built, some of concrete and some of tarmac, linking up all the cave entrances and leading down past the Transportation Section constructed in the valley to the railway siding and the main Cairo–Helwan road.

No.101 MU continued to hold a number of caves in the area; cave No.5 on the north side of the valley was transferred in November 1942, and cave 23 in August – September 1943. Apart from No.5 all other caves on the north side of the valley belonged to Egyptian Government departments, and cave Nos. 9-11 for instance, were allocated to the Antiquities Department and housed some of the treasures from the Cairo Museum. In recent months a number of these caves have been handed over to the RAF and used for bulk storage.

In recent months also it has been arranged that a South African mine engineer from the Tura Military Garrison assumes responsibility as Caves Safety Officer. With a small party he has scaled loose rock from the interior and exterior faces and indicated where the stone pillars or buttresses should be erected to provide support where weakness is evident to his practised eye. Gypsum seals or tell-tales have also been placed across some cracks, and these are inspected by RAF personnel daily so that the first signs of movement are detected. All falls, even of rock splinters or dust, are reported to the Safety Officer so that he may make note of this evidence. Although the caves have stood for upwards of 5,000 years it does not follow that they will continue to stand indefinitely, and they have been weakened by the removal of the loose quarry rubble within them which acted as a shock absorbing buttress.

Power supply

In order to work in the caves they had to be lit; and the growth of the electric power supply forms an interesting study which reflects the growth of the unit itself.



The power station in the engineer's yard built in 1943 to house two 120KW sets

The first power station consisted of a 20KW petrol-electric set in a small building below the entrance to cave 22, and this operated in July 1941. This was supplemented by a 60KW mobile diesel-electric set outside cave 27, followed by three 120KW static sets inside cave 27 installed in August 1941, April 1942 and November 1942 respectively. Finally, the present power station in the station engineer's yard was constructed to house two further 120KW sets installed in December 1943 and February 1944; the three sets in cave 27 being subsequently transferred to the new power station and completing a 600KW installation by September 1944.

Personnel

From a strength of about 50 in November 1941 the unit grew to 47 officers and some 350 other ranks in July 1942, increasing to 777 other ranks in May and to over 1000 by July. The strength reached a maximum of 1355 other ranks in February and March 1943, since when it has declined slowly to the neighbourhood of 1000 throughout 1944, exclusive of No.1 R.I. & MU, attachments and East African Guards.

Civilian personnel, apart from those employed on works services, increased from 1500 in 1942 to 2000 in 1944

with the training of more civilians to higher skilled jobs and the dilution of service personnel accordingly. 100 WAAFs came to work in the unit in June 1944, being at first accommodated at Helwan and making the double daily journey. After December they were accommodated within the unit.

Equipment section

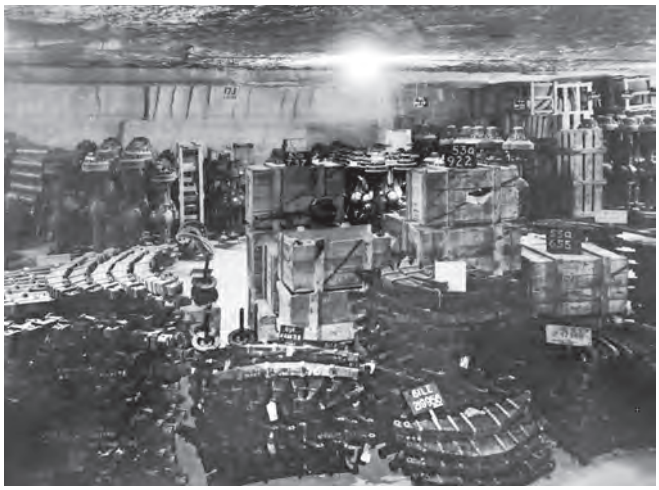
The equipment holding sections occupy 75 percent of the cave area, and the equipment stored in the caves covers a wide range. It has been reliably estimated that the aggregate value approximates forty million pounds. The original policy intended for the unit when it was first opened appears to have been to hold bulk stocks of equipment to act as a feeder for other equipment units in the Middle East. After the first six months, however, the policy changed to that of a conventional Universal Equipment Unit. With the retreat to El Alamein it was decided to disperse equipment holdings further afield, and 50 percent of complete stocks were transferred as pack-ups Bint and Koko to Ramleh and Khartoum respectively.

Glass items bulk storage area

Photographic equipment store in cave 24B

This monumental task was undertaken in three weeks during which personnel averaged between 18 and 20 working hours per day. In the latter part of the same year stocks were increased again by 300 percent, and again necessitated prolonged working hours in receiving equipment and meeting the demands of the Desert Air Force.

Bulk storage in an unidentified cave



Bulk M.T. spares possibly in cave 19

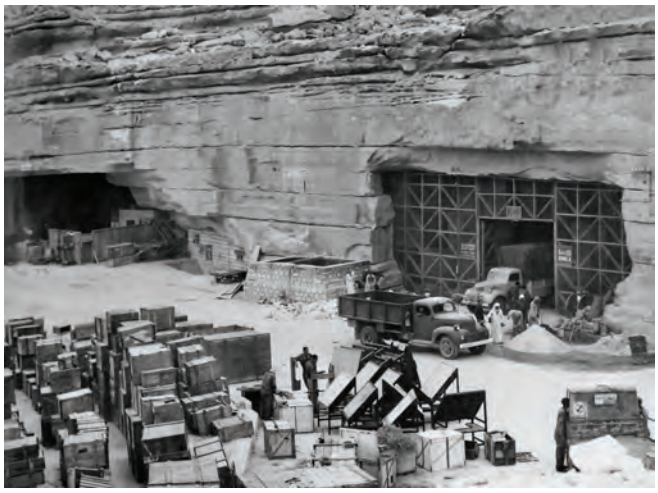
In March 1943 a violent rainstorm inundated the valley, resulting in the loss of stocks of dopes and paint stored in the open valley bed. Still heavier storms occurred in May 1945. There is not sufficient storage space in the caves for all the equipment held, and bulk storage for many Groups is left in the open, covering an area of some 350,000 square feet.

Bulk Tyre storage in cave 18

Bulk Tyre storage in cave 18

Caves storage

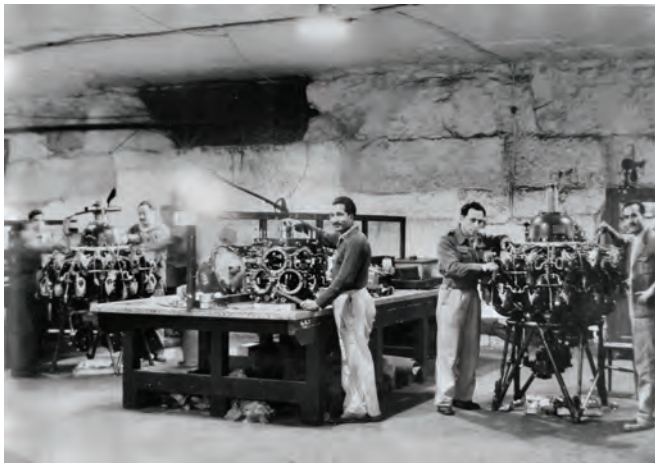
Conditions of storage in the caves leave little to be desired. The temperature near the cave mouths naturally varies very closely with seasonal change; but at a depth of 100 metres inside the galleries the annual variation is from 70˚F in winter to 77˚ in summer, while the relative humidity varies from 35 to 59 percent. The air remains fresh except where an unusually low roof is encountered, as occurs in two places, and in the plating shop, where extractor fans have been installed. For rubber storage, the exclusion of daylight and the dusting with fine limestone powder, which takes place naturally, provide ideal conditions.



Entrance to cave 23 tyre store with the entrance to cave 22 paint store in the background

Aircraft engines

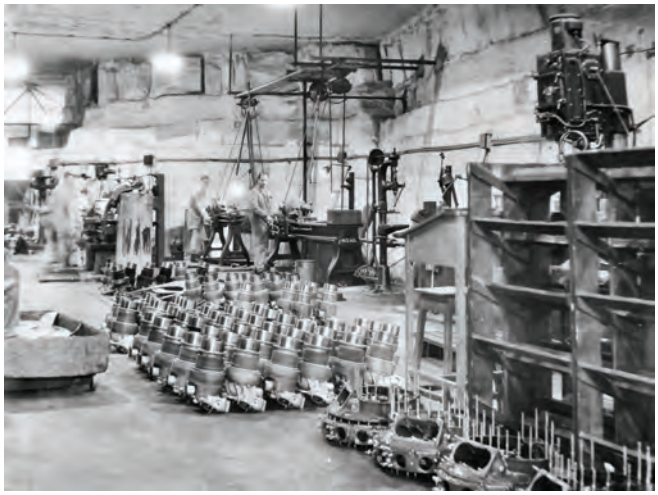
The production of engines commenced with the overhaul of American engine types, chiefly Allison and Pratt & Whitney, in cave 26G in December 1941; this engine repair section came to be known as No.3 ERS. Another ERS party which came from No. 107 MU and was temporarily housed in the Massara Cement Works moved into cave 26H in January 1942, moving to 26I in March; this party commenced overhauls of Merlin engines and became known later as No.5 ERS. In the following month cave 26M was prepared for Cyclone engine overhaul and linked up with No.5 ERS also.



Engine Repair Shop in cave 26

In June–July 1942 enemy air action brought to a standstill the production of Bristol poppet valve engines at Heliopolis. Accordingly the Cyclone shop was moved from cave 26M to Mansourah where it was subsequently known as No. 5 ERS and Pegasus engines were introduced into this cave. The Merlin shop was also moved to Ramleh, Palestine, and Mercury engines were overhauled in cave 26I in their place.

These two Bristol engine shops became known as No.2 ERS. No.2 ERS was soon to turn over to other types however, and in November 1942 Pegasus engine overhaul in cave 26I came to an end and was replaced by Packard Merlins, while in June 1943 Mercury engine overhaul in cave 26M gave place to Rolls Merlins.



Radial engine cylinders in cave 26

On November 1 1943 cave 26M changed again, this time to Hercules and Merlin power plant production, which has continued to the present time; and cave 26I took over overhaul of all types of Merlin. The production of Merlin engines ceased in August 1944, and No.3 ERS occupied caves 26G, H, and I, still maintaining its major commitment of Pratt & Whitney engines with a few Allisons and Warner Scarabs thrown in.

Production of all types reached 200 per month in the latter half of 1942 and peaked at 284 in April 1943. It has since declined to around 100. Total production for 1942 was 1520 engines, and in 1943 a total of 2209 was achieved.

In 1944 the total fell to 1003. The frequent change over from one type to another naturally mitigated against a continuously high production rate.

Test benches

During 1942 the test benches at Helwan were operated by the unit in addition to the ten benches which were in use at Tura by the end of the year. There are now no less than 20 benches. They are all sited in the open, in an area to the south of the main camp below the escarpment.

The total number of engines tested in 1942 was 2050 including 440 tested at Helwan. In 1943 a total of 2744 engines was tested, and in 1944 the figure declined slightly to 2612. Testing is carried out at Tura for engines overhauled at No.109 MU as at No.111 MU.

Propellers

Propeller production commenced in caves 26K & L in April 1942 and the output reached 898 by the end of that year. In 1943 a total of 2316 complete propellers was produced, with an ever increasing production rate which peaked at 265 in November.

Outdoor propeller receipt area

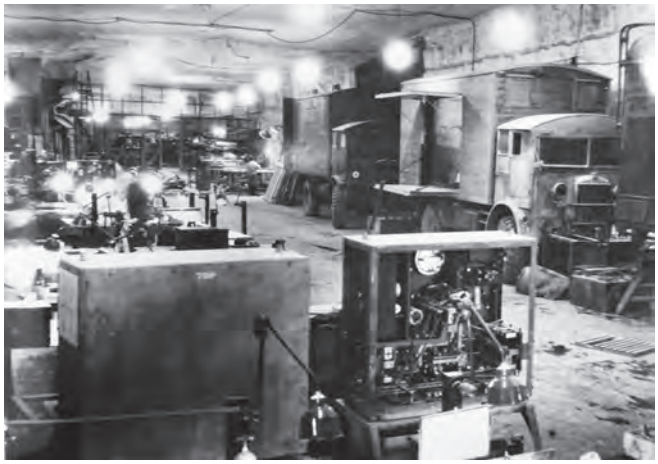
Men working in the Propeller Shop in cave 26

In March 1944 a new peak of 322 propellers was achieved, and production has averaged well over 200 since, contributing a total of 3041 propellers for the year. Propeller blades and constant speed units are also delivered from the shop, which is fully equipped in all respects.

Other sections

GES machine shop started in April 1942, in the entrance to cave 26I, with five machines which were increased to 10 within the month. The shop now contains 32 machines. Signals Repair Section started operations in cave 26N during February 1942 where it remains and handles many types of airborne radio equipment as well as teletype machines and high speed W/T equipment. An airborne Radar Repair section shares the cave, and it is of interest that this equipment is tested by sighting on the Giza pyramids some 12 miles distant, which provide an excellent echo.

Instruments and Electrical storage in cave 23C



Possibly the ground radar repair workshop in cave 26N

An Instrument Repair Section was accommodated in the old accumulator factory near Tura El Asmant village, but was transferred to No. 107 MU for the formation of No.113 MU (Tripoli), in March 1943.

An Electrical Accessories Repair Section also shared the accumulator factory from August to October 1942, when it broke away and was accommodated in cave 26B. In July 1943 there were falls of rock in this cave, and due to this the section was moved to No.107 MU.

The Magneto Repair Section is now accommodated in the old accumulator factory, and was formed in June 1943 by merging the magneto sections of Nos.1, 2, 3 and 4 ERS's, all of which it now serves. The sparking plug section was in existence in the Massara Cement Works for a year previously.

Assembling survival packs in the Safety Equipment Section

Parachute storage in cave 17

An Electro Plating Shop commenced operation in the southern part of the 'Cathedral' cave in July 1942, and now contains three large chromium baths as well as smaller baths for cadmium, copper, nickel and zinc and a lead flashing plant.

Caves hospital

Up to November 1942 Captain Outred, RAMC, Medical Officer to the Tura Garrison area, accepted responsibility for sick parades at No. 111 MU in addition to his ordinary duties, and it was he who suggested that a combined Army–RAF medical reception centre might be opened in one of the caves. Cave 42 was accordingly selected, and what is now commonly referred to as the Caves Hospital opened to receive patients on 22 March 1942. In the meantime also, an M.I. room was opened in the domestic camp for daily sick parades, and a Dental Centre was added to this at a later date.

The domestic area

It is not intended to say much of the domestic area as there is nothing essentially unique about it. All Personnel are accommodated in tents, with the offices, NAAFI, YMCA dining hall, ablutions and latrines of local stone. Mention must be made of the station church, which was built by the airmen in off-duty hours.

The foundation stone was laid by Lady Rosalinde Tedder in November 1942 and the opening ceremony, which was broadcast by the B.B.C., took place on 6 June 1943. The unit is also justly proud of the facilities it provides for sport and entertainment, which can be claimed to equal, if not exceed, those of any other unit in the Middle East.

References

AIR 29/1040/2
111 Maintenance Unit, formed Tura, near Cairo, Egypt, August 1941; split into 'A' Echelon, Tura and 'B' Echelon, Boulac November 1941; ['B' Echelon renamed 109 MU April 1943]; disbanded March 1947. With appendices
AIR 20/5534
Tura caves Egypt: No 101 Maintenance Unit storage system; photographs.

Dining hall, cave location unknown

Dunham-on-the-Hill – an unusual Royal Ordnance Factory

Phil Pritchard

One of the grassed magazines still in its original state.

The title "Royal Ordnance Factories" was the collective name of the UK Government's munitions works during and after WWII. Until privatisation, they fell under the Ministry of Supply (MoS), and then latterly the Ministry of Defence (MoD). During WWI, the equivalent was the NEF (National Explosive Factory) and the NFF (National Filling Factory).

Some factories were built and run by the government, others were built and owned by ICI, but were not considered to be part of the MoS ROF organisation, and were not called ROFs. Other MoS funded factories were managed by ICI, and were known as Agency Factories. Other ROF Filling Factories, especially later in the war, were managed in a similar manner to the Agency Factories, but by organisations not normally connected with armaments.

During WWII, new ROFs were constructed, but usually in areas that were considered "safe", i.e. northwest of a line drawn from Weston-super-Mare to Bristol, to Haltwhistle (Northumberland) and then to Linlithgow (west of Edinburgh). There were however some exceptions to this geographical rule.

The three main types of ROF were:

- Engineering
- Filling
- Explosives

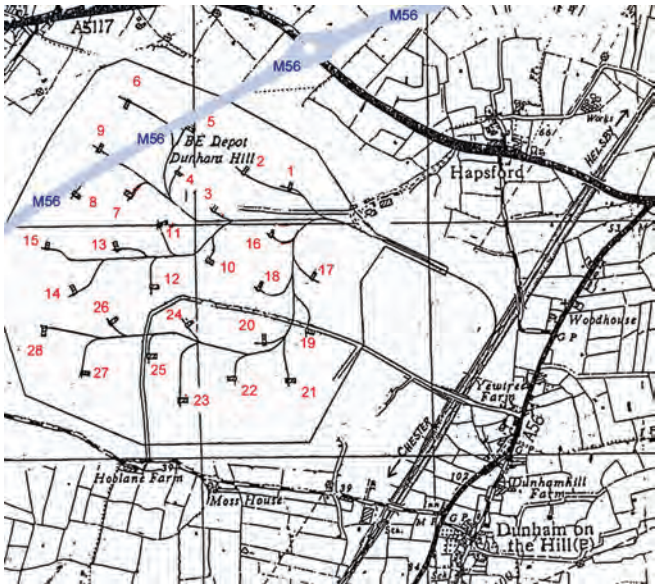
The above three types were also the biggest, as the buildings had to be widely spaced.

The other three types were:

- Medium Machine Shops
- Small Arms Ammunition Factories
- Rifle ROFs

These tended to be self-contained, with regards to power, hostels, domestic arrangements, well-being and accommodation. The Ministry of Defence Police maintained security.

Some sites were designated temporary', i.e. only extant until the end of WWII, while others were 'permanent' –



This map shows the internal layout, perimeter fence line, the railway line, the numbering of the sheds and magazines, and the route of the modern M56 motorway

and continued in use after WWII. These WWII survivors eventually succumbed to a wide range of fates, the later surviving ones becoming part of QinetQ.

This particular depot, known as "DotH", is often marked on period maps as "B.E.", i.e. a "Bulk Explosive" store.

Introduction to Dunham-on-the-Hill

This is a puzzling site. It is easily visible from the M56 northeast of Chester, travelling in both directions. The most frequent view is of the two brick "sheds" from the M56, travelling past the Helsby turn-off towards North Wales.

The "sheds" seem too big to be normal agricultural barns; one end is obviously intended to be driven through, but at the same time is far too big for even a modern heavy goods vehicle. They look like a typical WWII structure, but not quite. After driving past several times, it is then obvious that there are other "sheds", scattered around the fields. Some are not quite the same, some are the same; some have earth banks, some do not; some have standing brick walls, some do not; some standing walls have diagonal markings, others not.

The examination of aerial photography websites reveals a considerable number (28) of these sheds, and visual hints of tracks connecting them. They look military, and they start looking like an ammunitions storage area.

Casual discussions with local people suggested that the site was a munitions dump, built by Italian PoWs in World War I, that it was owned by Cheshire CC, and that it was currently used for agricultural purposes. One good source stated that earth banks were essentially clay, and were taken away and used to line the nearby Cheshire CC Gowy landfill site.

One of the magazines, now devoid of earth banks and cover, stands in the middle of a cornfield

The site appears to be very large, but with very little information available, even to the extent that the name was missing.

Signal box clue

Internet searches revealed very little information. The key fact, discovered in a Signal Box directory, was that the main line signal box (Dunham-on-the-Hill No.2) was a Midland Railway ARP (Air Raid Precautions) design dating from World War II, which was designed to be operational even after a close miss from an exploding Luftwaffe bomb.

An Internet search for the signal box came up with a reference to a *Railway Modeller* magazine article, written by a member of the Merseyside Model Railway Club and published in December 1990. The article had a few words about the ROF site, but was essentially concerned with the signal box, which was of historical interest in railway circles.

Despite the main function of ROFs being the manufacture of munitions, DotH was to be different. It was not actually involved in manufacturing at all. It was primarily for the storage and distribution of explosives that were then to be used in other ROF establishments as fillings for shells and munitions.

Some of the magazines are used to store straw bales and other farm material but most stand empty as seen here in August 2018. Photo Mike Searle.

Reproduced under creative commons licence from Geograph

The DotH site was built on a site requisitioned in 1941 for the war effort, on behalf of the Ministry of Supply (MoS) under the Emergency Powers (Defence) Act 1939.

Construction at the site started on 7 June 1941, completed by 5 August, and was open for use on 11 August 1941. The supplies were initially received by the nearby already existing Dunham Hill station goods yard. The LMS railway was given a special licence for the right of access.

The site hits the buffers

Upon cessation of hostilities, the depot was retained for food storage, eventually ending up responsible to the Ministry of Agriculture, Fisheries and Food (MAFF). This role ceased in September 1985, and in 1990 it was disposed of into the private sector. When used in this latter role, it was known as a "Buffer Depot".

The stored food included large tins of baked beans, margarine, butter, cocoa powder and dried milk. Local information is that the food, after the depot's closure, was to be stored in "old mine workings", and was removed by road vehicles.

Some of the food was certainly transported by road to a company named Lovell & Christmas. As a Buffer Depot, the food was regularly replaced. The stored food initially included tins of corned beef, but after a batch released onto to the open market was blamed for an outbreak of Typhoid, the storage of corned beef was ceased.

Railway track embedded in the concrete floor is still clearly seen in the open end of the magazines

Looking out of one of the magazines the railway track is seen embedded in the concrete. Photo Mike Searle. Reproduced under creative commons licence from Geograph

There were very few workers on the Buffer Depot site, mainly warehousemen. There are also recollections of the depot being used for the storage of machine gun bullets, and other items that were manufactured at ROF Capenhurst, which was only a short distance away, presumably before Capenhurst took on its "nuclear" role.

The Role of DotH in WWII

The main role of DotH during WWII was for the storage of explosives, but there is a significant story behind this role.

Explosives during the war were shipped into the Mersey ports. The geographical position of DotH was very appropriate, as it was in a very good strategic position on the railway lines in the area.

The site was not chosen by chance. It was in a position to receive the explosives and munitions, and then to store them for further distribution to other ROF factories and filling depots. The workers recollect shipments from Canada, then distribution to ROFs at Fazakerley, Rhydymwyn, Chorley and Chelford.

Railway track can be seen around the site embedded in concrete paths

The explosives were mainly Neonite, Cordite and TNT; they arrived packed into cloth bags, which were in turn packed into wooden crates and boxes. There were also substantial quantities of ammunition boxes and cartridge cases, as well as boxes of 'yellow powder'.

This distribution activity made the local railway line very important to the war effort. There are some local defensive weak spots to the railway, namely a cutting, and the Frodsham Viaduct, which crosses a wide valley over the River Weaver Navigation. This can easily be seen from the M56 Frodsham Viaduct.

A road bridge across the cutting was protected by a pillbox, which still remains to this day in the corner of a private garden on Wood Lane. The viaduct itself was protected from air attack by two Heavy Anti Aircraft (HAA) gun sites, each with four guns. They are situated off Aston Lane and Townfield Lane. The example on Aston Lane is still in excellent condition and a credit to the owners. The only remains of the Townfield Lane site are pieces of broken concrete used in the gardens, walls and rockeries of local housing.

Construction of DotH

The building of the DotH site was subject to the usual WWII secrecy, and misinformation that abounded. One quantity surveyor that worked on the project stated that it was an 'Empty Component Store', and that it was to be associated with Risley ROF No.6, and the nearby Hooton ROF No.10 (still known locally as Roften).

Many of the earth banks surrounding the magazines survive

Note: Hooton (Roften) ROF No.10 has also been demolished, in 2014. He believed it to be just a storage depot, but did query as to why the buildings were so dispersed, and as to why some had earth banks surrounding them, but in those days, it was not the 'done thing' to ask questions.

DotH was built at the start of WWII, on a flat, marshy area adjacent to the Mersey estuary between the Hooton to Helsby and Chester to Helsby railway lines. It was intended for the bulk storage of explosives, and as such, also had to be remote from centres of population.

The site is roughly a mile square, and has an irregular perimeter of between four and five miles. The storage of the explosives was in a number of brick and steel "sheds", 28 in total, which included ten "sheds" which were designated as 'magazines'; these were surrounded by earth and clay blast mounds, with a brick blast wall at the rail entrance as it was a weakness.

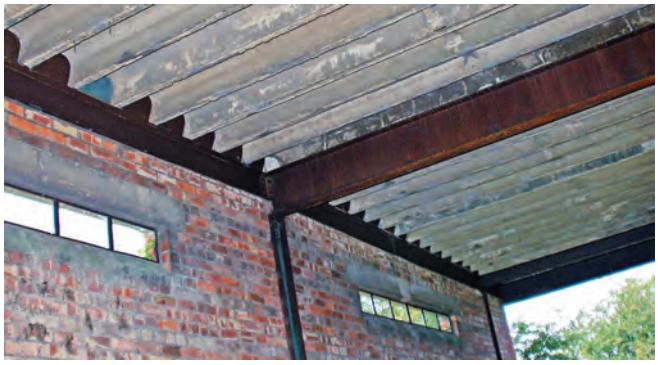
Details of the sheds and magazines

The earthworks that were used as blast barriers around the magazines were constructed using a narrow-gauge railway, with a petrol engine locomotive which pushed tipper trucks around the site. The driver sat sideways in the locomotive. The main construction contractors were a company called Demolition and Construction Ltd.

Note the water butt for collecting rain water from the roof

There were 28 main storage sheds, ten of which were designated as 'magazines', and were located in the centre of the site. The term 'magazine' was used within ROF sites, but many were much smaller, and some not even rail connected. The correct term for the Traversed Sheds (Earth Banked Buildings) is Explosives Store Houses (ESH).

These one-sided ESH buildings are of the same design as could be found at CAD Bramley in Hampshire, and at CAD Kineton in Warwickshire. Most of the examples at CAD Kineton were demolished in the mid-70s to 80s to make way for a new depot, leaving only three remaining. CAD Nesscliffe was a mix of this single-sided design of ESH, and a centre access design, which was also earth covered.



Interior roof detail of the magazines

Some of the ESH buildings have had the earth mound removed by Cheshire CC, and taken away to line the nearby Gowy landfill site. These are obvious, as they usually have a substantial brick blast wall at the point in the bank where the railway track would enter. Where the mound has been removed, it usually leaves a diagonal line on the blast wall.

A magazine that has had the surrounding earth mound removed – note the diagonal earth line on the brick blast wall to the right

The sheds are approx. 35 metres long, and 12 metres wide (measured at the "storage" section), and 15 metres wide at the loading / unloading dock end. The engine shed is slightly smaller at 19 m by 6 m.

This magazine still retains its ladder for access to the roof. It also appears to be one of only a few that are being used by the farmer. Photo Mike Searle.
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The buildings were constructed of a lightweight steel framework, filled in with a single layer of common bricks. Each building had a small 'sentry box', on the storage

side of the entrance; nearby was usually a concrete pipe water butt, with asbestos guttering and downpipes. The roof was made of very lightweight concrete sections, and covered in asphalt.

There were lines of glass lights set into the brickwork at the top of the walls. Each shed had a steel ladder for access to the roof. The sheds did not contain any electrical wiring, lights or fittings, obviously because of explosion and fire risk.

Security

The security was the responsibility of the Ministry of Defence Police, but there are also recollections of a detachment of the Home Guard being stationed there, and being accommodated in huts for the duration.

The whole site was surrounded by a single line of seven-ft-high chainlink fencing with concrete posts seven feet apart, with the usual barbed wire on top. Significant lengths of the fence still remain. There were four security men per shift, and a gateman.

A surviving pillbox along the perimeter of the site

The patrols were usually done by two security staff (who worked a three-shift system) with Alsatian dogs. There were two types of passes, which had to be produced for entry; additionally, workers were searched at the gates for matches and cigarette lighters. The two types of passes were one for the workers, and another for the farmers, presumably to attend to the cattle. At times during WWII, there were as many as eight gates used for access onto the site – each gate had a sentry box and guards.

A surviving sentry post. Photo Mike Searle. Reproduced under creative commons licence from Geograph

In an effort to keep up the war effort, and to keep the grass down, cattle (both for milk and beef) were allowed onto the site for grazing.

Domestic and working arrangements

The local workers travelled to the site either by foot, bicycle or by rail services to Dunham Hill station, which was adjacent to the ROF site.

There was a hostel on the site during WWII, but most of the people accommodated in the hostel worked at ROF Capenhurst. The hostel is now the site of a travellers' encampment. The hostel area also included some bungalows, as well as separate Nissen huts for men and women. There was also a canteen. Helsby Grammar School was also used as a hostel during WWII for DotH workers, as well as another hostel at Lowton St Marys, near Wigan.

The total number of workers was around fifty, including a substantial number of Irish, Welsh and Geordies. The workforce had a regular skilled core of local people, and a varying number of transient workers. On some occasions, men were transferred by rail between DotH, Beeston fuel dump, Mickle Trafford ammunition dump and Ince petrol dump.

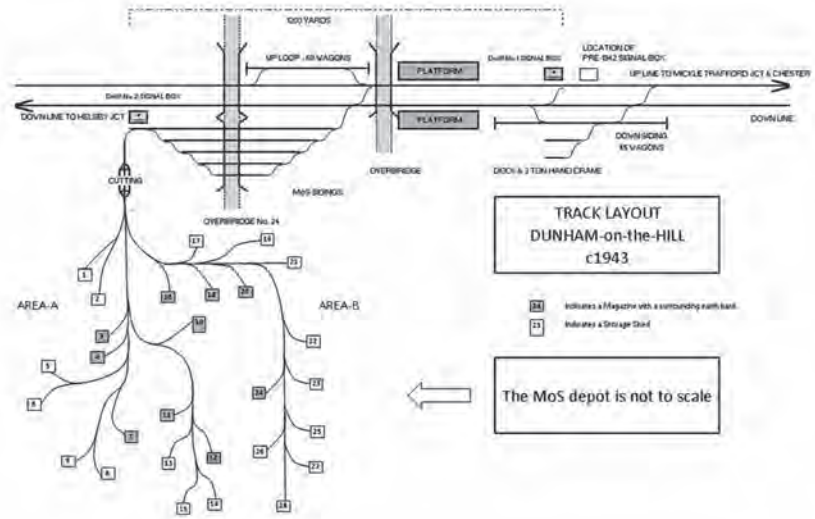
The transport around the site was primarily by tram; bicycles were also used extensively. During the war years, there were two shifts, 6-2 and 2-10.

All the magazines and sheds had an opening at one end for access and for the site tramway to pass in and out of the building

Railways – General

The storage "sheds" were all rail-connected by standard-gauge track work, laid on clinker and ash ballast, and mostly bolted onto concrete railway sleepers, except (as is usual) underneath the points. The points were hand-switched. There were around five miles of track, and 30 sets of points. Each shed had its own siding, and buffer stop.

There was a mainline rail connection (to the L.N.W. & G.W. Joint Railway), and sidings, access to which was controlled by a LMS 'ARP' signal box, which still exists. The sidings were over half a mile.



This map shows the main line railway, sidings, signal box locations and the connection to the internal rail network, as well as the shed and magazine numbering

The explosives arrived by rail and the wagons were stored in the sidings until being brought into the site by the MoS 4-wheeled diesel shunters. 'Match' wagons were inserted between the goods wagons and the locomotive, then they were shunted (usually in groups of four) to the storage sheds, where they were unloaded, one at a time under cover.

For safety reasons, the 'match' wagon was to prevent the diesel shunter having to enter the storage shed, and the explosives were manually unloaded onto wooden supports, i.e. there was no motorised assistance. Trains on the mainline railway system used 'Buffer Wagons' of inert stores or two empty goods wagons to create a spacer between the locomotive and the wagons carrying explosives.

Both Saturday and Sunday were allocated to maintenance work on the shunters. There were two small loco sheds on the site, one for maintenance with a pit, the other for storage only. The shunters were ostensibly allocated to the Chester 6A locomotive shed for heavy maintenance, with the drivers being employed by the MoD.

One worker recalls starting employment in the sheds, then becoming the Foreman, having to drive the locos when required, and eventually becoming the full time driver when the usual driver retired. Later, he moved on to become a watchman, working shifts because the pay was better.

There were two gangs in the engine sheds up to 1949, reducing to nine workers by 1959. The site traffic was very busy until 1944, when the ROF work started to decline. The site had an underground fuel dump, holding diesel for the shunters, and petrol for road vehicles and the personnel tram.

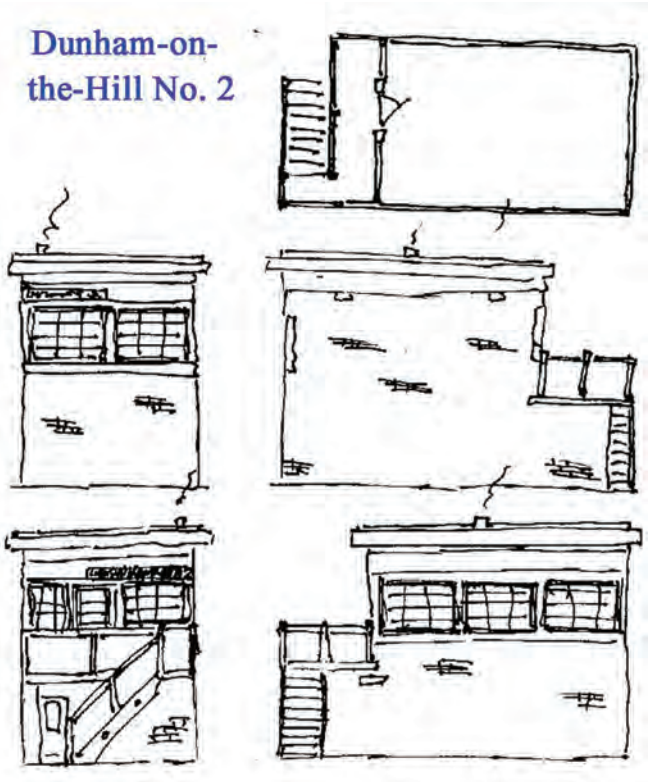
Railways – Signal Box

To provide control of access into the site, a new signal box was required. This was named Dunham-on-the-Hill No.2. It was built to Air Raid Precautions specification, usually abbreviated to ARP. To meet the specification, it had to be able to resist damage from direct incendiary bomb hits, and the blast from nearby larger bombs. There were very few openings in the walls. Heating was by oil lamps, and drinking water had to be transported in containers, neither of which was unusual at the time. The roof was a 12-inch-thick reinforced concrete slab.

It was built in 1942 by Cartwright Massey of Warrington at the same time as the construction of the depot. This particular example is known (by the Signalling Record Society) as a LMS ARP Type-11. There were over fifty of this type built by the LMS.

After the war had ended, there was little signalling activity, and the signal box was subject to a temporary closure in 1946, kept in a maintained condition, followed by complete closure in 1949.

Dunham No 2 ARP Signal Box



Sketch of Dunham No 2 Signal Box

The box controlled access to the sidings at the east end, and had 20 levers, although only sixteen were used. At the west end of the sidings there was another ARP signal

box, Dunham-on-the-Hill No.1, built at the same time as No.2. This replaced an 1873 signal box that was too small as a consequence of opening the DotH depot. The No.1 had 40 signal levers, and was closed in 1969.

Reputedly, and by definition, the ARP signal boxes are difficult to demolish; despite this, there are few examples remaining.

Railways – Locomotives

There were usually at least two shunting locomotives on the site, one in use, and the other on standby as a spare. Locomotives usually arrived on site by road, and were unloaded onto the tracks sideways.

The Fowlers were reputed to have an awkward 'gated' gear change, and had a conventional starting handle. The Andrew Barclay "Kent" locomotive had pneumatically operated controls, and required a charged up air tank for starting.

All locomotives wore a dark green livery. They had water exhaust traps, so that sparks could not be emitted from the exhaust, for obvious safety reasons whilst handling explosives.

There was also a tram type of rail vehicle, for transporting workers around the site. It featured a roof, and no sides, but was capable of carrying six people (probably not in comfort). It was driven by a petrol engine, and had a friction drive. The driver was always one of the loco men on the roster.

A locomotive shed survives amongst the magazines scattered around the site seen here in August 2018.
Photo by Mike Searle, reproduced from Geograph under creative commons licence

Locomotive Details

There were a number of locomotives recognised at various times as being allocated on-site. The normal arrangement was for local numbering schemes; however in 1961 the War Department (WD) assumed responsibility for locomotives at ROF locations. The ROF locomotives were then renumbered into the WD scheme. The locomotives are tabulated below:

Dunham No 1

0-4-0 150hp, 29 tons Diesel Mechanical Shunter

Manufactured by John Fowler (Leeds), Works No. 22978 in 1942

Ex-factory 13/06/1942, delivered new to DotH on 15/06/1942. However, the track was not ready, and there was no locomotive shed. The locomotive was used for driver training, and entered service 06/07/1942.

Sold to T.W. Ward, Grays, Essex Circa 1953, and overhauled June 1954.

Sold to Joseph Boam Ltd. Middleton Towers Sand Pits, Norfolk Circa 1963

Withdrawn circa 1967 as "beyond economic repair"

Disposed of circa 1969 – assumed to be "scrapped"

Dunham No 2

0-4-0 150hp, 29 tons Diesel Mechanical Shunter

Manufactured by John Fowler (Leeds), Works No. 22985 in 1942

Ex-factory 24/09/1942, delivered new to DotH on 25/09/1942

Sold to a dealer, Abelson at Sheldon November 1950

Sold Furness Shipbuilding Co. Ltd. Haverton Hill, County Durham by a dealer G.E.Simm Ltd, circa 1952

Dunham locomotive No 2 'Kent'

Dunham No 3

Scrapped circa 1959, the frames were retained as a "bogie truck". 0-4-0 150hp, 29 tons Diesel Mechanical Shunter

Manufactured by John Fowler (Leeds), Works No. 22987 in 1942

Delivered new to DotH October 1942

Moved to ROF Ulnes Walton 29/11/1042

Dunham No. 2 "Kent"

0-4-0 150hp, Diesel Mechanical Shunter

Manufactured by Andrew Barclay, Works No. 331

Delivered new to Royal Arsenal, Woolwich 13/06/1938

Moved to DotH February 1953 after repairs at FC Hibbard & Co. Ltd, Park Royal

Moved to ROF Chelford, Cheshire 27/04/1961

Moved to WD Bicester workshops, Oxon, renumbered as WD 861, 16/01/1964

Moved to MoD Eskmeals - Proof and Experimental Establishment, Cumberland, 06/11/1964, and renumbered WD 241 under the 1968 renumbering scheme.

Sold to Walsh and Dearden, Darwen, Lancashire 09/06/1977, and scrapped in 1980.

ROF No 5

0-4-0 150hp, Diesel Mechanical Shunter

Manufactured by Robert Stephenson & Hawthorn Ltd. Works No. 6968

Delivered new to MoS, ROF Rotheras, Herefordshire, 1938

Moved to DotH, April 1950 (Assumed to be a short loan)

Moved to ROF Rotheras, Herefordshire

Moved to J.W. Hardwick & Sons Ltd. West Ewell for scrap, circa 1962

Postwar

There was a regular annual landscaping maintenance of the grounds, and some pest control in the spring, which was done by a Leicester company. The site saw little activity immediately postwar, but that was soon to change in 1956 with the Suez and Hungarian crises.

Suez Crisis

The last recalled "military" use was during the Suez and Hungarian Uprising crises in 1956, when the depot was used for the storage of shells, including American ordnance. The shells included Phosphor bombs.

The local construction company (McAlpine, based at nearby Hooton) was employed to rebuild and repair the earthworks around the magazine sheds, and to repair the fences around the magazine earthworks – presumably to keep the cattle off. Additionally the lightning protection was redone.

Post 1957, the site was used for storing Ammonium Nitrate in 2 cwt drums (112 pounds). This was stored in the open, and was later burnt off in the open air between 1957 and 1958. The local populace was informed by telephone before burning began.

Closure and reuse

The signal box at Dunham-on-the-Hill station (not the No.2 ARP signal box) station was closed around 1956, and demolished soon afterwards. Although Dunham-on-the-Hill station closed in 1952 a closure notice for the No.2 signal box was posted for 24 November 1951. After closure the lever frame was removed and signal box remained becoming derelict until it was demolished on 9 November 2008 due to, despite its remoteness, becoming a magnet for local youths

Track lifting within the site started in early 1963, and finished in 1964. The labourers were bussed in from Walton Jail, in Liverpool. The track leading to the site was left in place for the CEGB, who at the time had outline plans for a power station on the site; however, these plans did not come to fruition, and the track was lifted sometime in 1966/67.

The entire site was leased by Cheshire County Council, for several purposes. One is the obvious travellers' camp, accessed from the A5117; another being to use the earth embankments (which were actually clay) as an easily

Dunham No 2 signal box in September 2008, shortly before it was demolished. Photo David Ingham

accessible source of clay to line the nearby Gowy landfill site. This explains why some of the "magazines" have had the embankment removed, and also explains the diagonal line present on some of the brick blast walls where the rail entrance would have been.

E.R.O. 19092
W1—No. 47

BRITISH RAILWAYS
LONDON MIDLAND OPERATING AREA

(WESTERN DIVISION) **W1**

THIS NOTICE MUST BE KEPT STRICTLY PRIVATE, AND MUST NOT BE GIVEN TO THE PUBLIC.

TEMPORARY SPEED RESTRICTIONS
PERMANENT WAY OPERATIONS
SIGNAL ALTERATIONS
APPENDIX INSTRUCTIONS ETC.
SATURDAY, NOVEMBER 24th,
to
FRIDAY, NOVEMBER 30th (inclusive) 1951

Sunday, November 25.—Dunham Hill No. 2.—The box will cease to be a block post and will be taken away. With the exception of the up colour light distant signal, which is also controlled as the up outer distant signal for No. 1 box, all signals including the up inner distant 1 signal for No. 1 box will be taken away.

The up colour light distant signal will be moved 470 yards nearer to No. 1 box and will continue to be the up outer distant signal for that box. This up outer distant signal will then be 950 yards from the up outer home signal for No. 1 box.

The control by No. 2 box on the dwarf shunting signals reading from up main to reception siding and from down main to reception siding at No. 1 box will be taken away.

On and from completion of the above work No. 1 box will be renamed Dunham Hill.

Receipt of this notice need not be acknowledged. If not received on Thursday afternoon, advise, "Trains, Crewe" by wire as follows :—"Nile Not 1."

W. B. SHELTON,
Divisional Operating Superintendent.

CREWE,
November 20th, 1951.

A BR Temporary Speed Restriction Notice, implemented during the closure of Dunham No.2 ARP Signal Box

Colour photos by Phil Pritchard unless stated

Memories of Vange Anti-Aircraft Operations Room: Plotting against Hitler

Martin Dixon

Air Defence of Great Britain

When most people think of World War II plotting tables then they automatically think of Fighter Command. But alongside the RAF the army also had a key part to play in meeting the threat posed by enemy aircraft. In particular Anti-Aircraft Operations Rooms (AAORs) – also known as Gun Operations Rooms (GORs) – were created as a result of the Air Defence of Great Britain (ADGB) organisation of the late 1930s.

A typical WWII GOR, this is Newhaven & Brighton in 1944. Photo from Imperial War Museum

The lead service in the ADGB was the RAF's Fighter Command who controlled the take-off and vectoring of fighters. Fighter Command's chain of command went from Command HQ through first four (later six) Fighter Groups, each of between three to seven Sectors. At each RAF Sector Operations Centre (SOC) was an Anti-Aircraft Brigade Commander (a Brigadier) who sat beside the Sector Controller.

If it was decided that engagement by guns was appropriate, the Brigadier ordered the AAOR to engage and gave permission to open fire. The AAOR was in direct contact with all its gun sites, and with ammunition depots. Within the Anti-Aircraft Operations Room, there was a large map table with the same coverage and grid as the SOC. This map was kept up-to-date by plotters from the Auxiliary Territorial Service (ATS), attached to the Royal Artillery.

Introducing Nora Thwaites

The 1st Anti-Aircraft Group defended the South East and the GDA (Gun Defended Area) of Thames North was controlled from 329 GOR at Vange, Pitsea near Basildon in Essex.

One of the ATS Plotters at Vange was Nora Thwaites, now 97 but still with vivid memories of her wartime service and experiences. We are privileged that Nora has recorded some of these memories and allowed us to print them along with 'then and now' photographs.

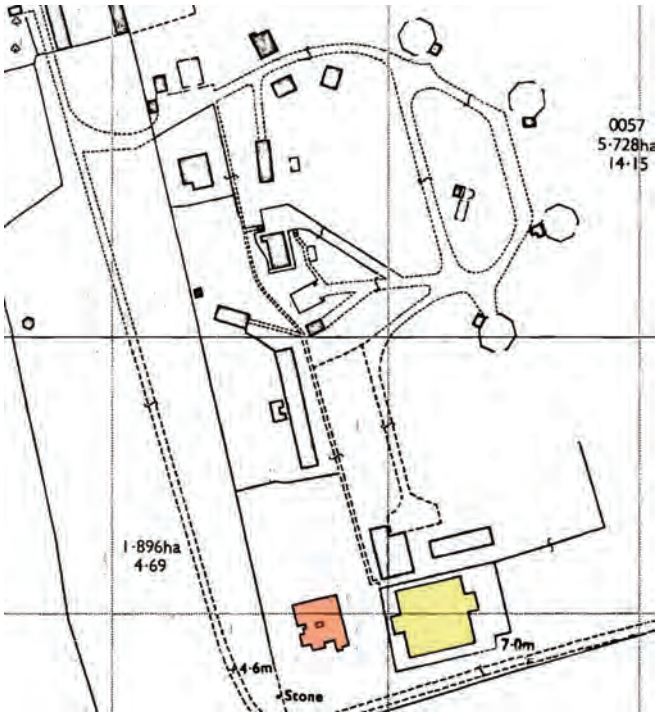
Nora in uniform during her wartime service

"When I was 16 I was living in the Isle of Man where my father was stationed. I met my future husband Ron on the island; he had just returned from Dunkirk and was posted

Nora on the Isle of Man with her future husband Ron (centre back)

to the Isle of Man. His job was as a guard in the Italian Internment Camp - around Douglas there were camps for Germans and Japanese as well as Italians.

I met Ron at the Saturday Hop, he was a dreadful dancer and had two left feet, dancing around in his army boots.



1975 1:2,500 OS map showing the layout of the Vange gun site. The WWII GOR is highlighted in red with the cold war (1950s) AAOR in yellow. The gun emplacements for the four 3.7" anti-aircraft guns installed after the war are seen top right.

329 Gun Operations Room Vange

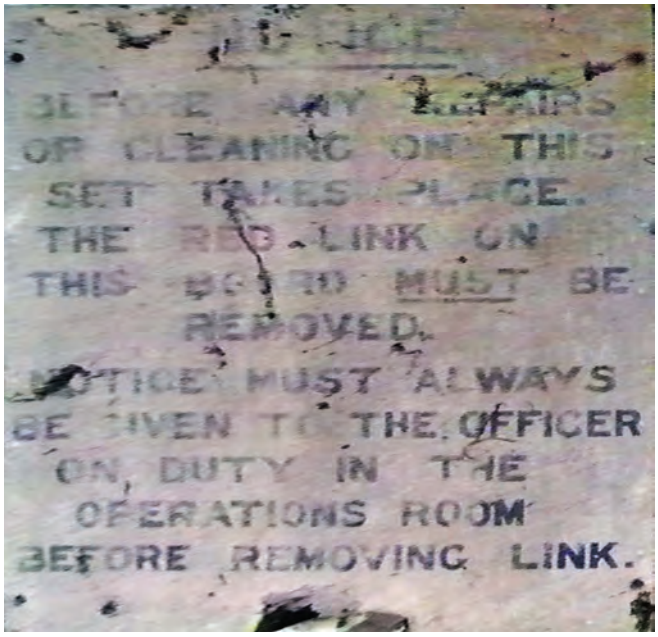
I joined the army at 17, so left the Isle of Man, and Ron got transferred so we lost contact. As part of the ATS I wore the ATS logo on my cap but the grenade badge of the Royal Artillery above my left tunic pocket. I was posted to Vange which was the Headquarters for controlling anti-aircraft guns north of the Thames.

As a Corporal I was in charge of nine other girls - you can just see my stripes in the wartime photograph. We lived on the camp and worked shifts to provide continuous cover. The plotting room was on the other side of the camp, close to the Fenchurch Street to Southend Railway Line.

Plotting

The plotting room was underground and there were about ten people in the plotting room at any one time. These included two Officers, a Sergeant and a Broadcaster who were up on the Dais or the balcony above the two plotting tables. The Broadcaster had to tell the gun sites where the enemy planes were approaching from and their track and height. **Editor's note***:* The building had brick sides and a concrete slab roof; it had no windows. Earth revetments around the building (now removed) gave the impression of being underground.

The plotting room held a large round table with a glass top, which was all lit up inside and had a black grid



A surviving WWII notice board on the wall of the operations room states 'Before any repairs or cleaning on this set takes place the red link on this board must be removed. Notice must always be given to the officer on duty in the operations room before removing the link'. Photo Andy Hebden

overlaying it. The table was manned by girls from the signal corps with earphones and long rods a little like snooker cues. They were given information over the headset of how many planes were approaching in a group, the information having been taken from radar sites.

Aerial view of the Vange GOR centre (left) and Cold War AAOR (right). Both are still standing. Other WWII buildings are still standing amongst the farm buildings.

We plotted the aircraft using four-figure numbers using discs. These discs included an arrow showing the direction of flight. Small flags were added to the plot, either with an 'F' for Friendly or an 'H' for Hostile. These plots were then used to notify the guns of the settings for their guns in order to engage the targets.

A typical period of alert and plotting lasted between one and two hours at any one time during the bombing attacks.

Happy Ending

During the war, Ron and I got back in touch and corresponded for a while. We eventually met up again after the war, and got married and had five children."

Editor's note: The Thames North Gun Operations Room at Vange was one of only a few purpose built structures in WWII. The majority of GORs were located in converted houses. GORs at Edinburgh and Glasgow were of a similar design to Vange. London anti-aircraft guns were controlled by the GOR at Brompton Road tube station and the guns at Medway from Fort Luton in Chatham.

External view of the WWII GOR, now devoid of its earth revetments. Photo Andy Hebden

Internal view of the GOR. This windowless room was probably the ops room. Photo Andy Hebden

Nora Thwaites today at age 97. The ATS cap badge and Royal Artillery Grenade badge can clearly be seen

Tunnelling through the Rockies for the Canadian Pacific's transcontinental railway, Canada

Canada's first transcontinental railway, the main line of the Canadian Pacific railway company, was made in the 1880s, but where the line crossed the Rocky Mountains running steam-hauled freight and passenger trains was problematical and expensive on account of the severe gradients. Inclines of up to 1 in 23 meant up to four locomotives end to end were needed to haul trains to the line summits, and the lengths and weights of the trains were severely limited. At the 'continental divide' at Hector (British Columbia) the line is about 5,335 feet above sea level.

West of Hector the railway descends almost a thousand feet in less than twenty miles into the Kicking Horse Pass. An easier gradient requires the same vertical descent in a greater distance. In or about 1907 engineers decided to accommodate additional lengths of track in two spiral tunnels bored through the mountainsides either side of the line. The new line was opened to traffic in August 1909. Eastbound trains thereafter gain about fifty feet in height by running in a complete circle inside Mount Ogden, then cross the Kicking Horse River before running round a second circular tunnel inside Cathedral Mountain to emerge another 48 feet in height. The combined length of the two tunnels is about 6,176 feet. The maximum gradient on this part of the line was in this way reduced to 1 in 45, so two rather than four locomotives now sufficed to pull the heavier trains.

Further west, another difficulty on the line was presented by heavy winter snowfall in the Selkirk mountain range where peaks reach heights of ten thousand feet. Trains ran through a long series of snow sheds to keep the line clear. This stretch was by-passed by the boring of what was, when opened on 6 December 1916, North America's longest tunnel at five miles 39 yards. This record had by 1961 been surpassed, in the United States, by the Cascade tunnel (seven miles 1,397 yards) and the Moffat tunnel (six miles 373 yards).

Your scribe adds: The drivers of very long freight trains can, on exiting one of the spirals, look back to see the last vehicles of their trains entering the tunnel around fifty feet lower on the mountainside. Passenger trains are not long enough for this to be the case. In the Alps, southbound trains heading through the Brenner Pass for Italy minimise gradients by running in tunnel loops either side of the frontier at Brenner, although these are not complete circles. Our own UK railways in the Scottish mountains are generally routed around the heights rather than tunnel below them: very long tunnels in Scotland are not to be found.

SOURCE: GREENING, W.E., 1961, Tunnel building in the Canadian Rockies. *Railway Magazine* 107(718), (February 1961), 127 - 129.

The Japanese WWII tunnel complex in Western Sumatra

Phil Baker

One of the side tunnels which opens into the upper part of a canyon

Mountainous Sumatra in Indonesia is the sixth largest island in the world, with around thirty volcanoes. It straddles the Equator to the west of Singapore.

A little history

The first European visitors to this part of the world were the Portuguese, followed by the Dutch in 1596. Sumatra was part of the Dutch East Indies and became known to the British when in 1817 Thomas Stamford Raffles arrived as Lt-Governor of a British East India Company pepper-trading settlement on the west coast named Bencoolen (present-day Bengkulu).

Bukittinggi, some 400km to the north and almost on the Equator, dates from the 1820s and is now the third largest city in West Sumatra with a population of around 125,000 people. Today it is a popular tourist destination. Should you visit Bukittinggi then don't forget to drop in on the Japanese Bunker, located in Panorama Park, across the road from the War Museum with its ex-Dutch Harvard 'gate guardian'.

In 1942 during the Second World War the Japanese invaded Sumatra and as Bukittinggi was a local administrative centre and in a strategic location, it

The main entrance

became a major Japanese citadel. In order to consolidate their hold on the local area and withstand the advance of Allied forces, the Japanese decided to build a network of tunnels, boring into the soft volcanic rock below what is now the Park.

One of the side tunnels leading to the canyon

The tunnels were completed in 1944. They were 'discovered' a decade later and opened to tourists in 1994.

There are similar complexes in other islands of Indonesia.

The bunker was dug by forced Indonesian labour. It is 1,470 metres long and 40 metres below the surface, covering an area of around two hectares. A main staircase descends straight downwards, with no thought about blast reduction by having bends in the access passage. There must be over a hundred steps (I forgot to count). The staircase leads to two parallel main tunnels which are roughly rectangular and three metres across. Between these main tunnels are 21 cross-tunnels which also lead beyond the main tunnels.

The bunker effectively became a self-contained fortress; it had multiple uses which included ammunition storage, barracks, meeting rooms, prison and torture room, kitchen, and dining rooms including for the thousands of *romusha* (forced labourers). There is also an escape passage; several of the side tunnels open into the upper part of a canyon which borders the Park, see the first picture, apparently for natural, and the only, ventilation.

Take a torch

There is no lining in the tunnels, just hewn rock. Apparently they have survived several earthquakes with very little damage. The tunnels are lit by an occasional floor-level lamp which makes exploring quite difficult especially as many side tunnels have no lighting at all and are home to interesting artefacts, according to notices by the entrances.

Many of the lights had a disconcerting way of changing colour from white to not-very-bright purple and orange as people approached, apparently to try to give the place 'atmosphere'.

I visited in December 2019 and when I went it was free to enter with no guides or supervision as the ticket kiosk was closed. So, when you go, make sure that you have a good torch and have a couple of hours to spend there. I didn't have enough time as I discovered it during a short visit to the Park with our group.

If you're interested in rocky tunnels with poor lighting, a lot of history but not a lot to see, this is definitely the place for you, but please spend some time and make notes for a more complete report.

The Wikipedia entry, https://en.wikipedia.org/wiki/Lobang_Jepang, has some more information. Google searches will find more visitor photos, some of which are probably better than mine!

Long steep steps inside the main entrance

Char-Coal Mining

Martin Dixon

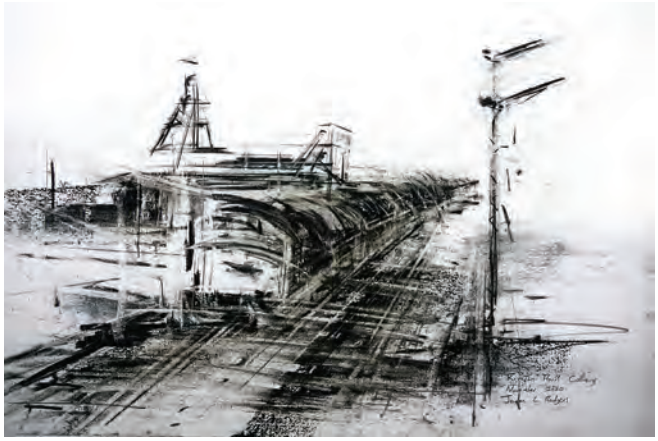
Jordan Rodgers, originally from the northwest of England, has a First Class Honours degree in Fine Art from Lancaster University. He has spent several years living and working in Eastern Europe. Based in Katowice, the capital of Silesia in Poland, his travels have taken him across Poland and also to the Czech Republic and Lithuania.

Alongside his work as an English language teacher, he has developed a growing fascination with the industrial heritage of Upper Silesia. Working in charcoal, pen and ink, he has sketched on location in all kinds of weather to immerse himself in the surroundings and to capture the atmosphere and perspective of the sites which are then turned into unique short stories told on paper. He has a particular interest in coal mining, an industry of great importance in Poland, although now struggling against cheaper importation of Russian coal. His experience has made Jordan feel like a real Ślązak (Silesian).

The impressive headgear at Astley Green coal mine and the adjacent winding house. Located by the side of the Bridgewater Canal, the mine has the only surviving pit headgear and engine house on the Lancashire Coalfield

Jordan's work has been exhibited in selected group and solo shows and published in national and international art magazines and websites, including the *Aesthetica* Art Prize, and the 100 Contemporary Artists Anthology, Jerwood Drawing Prize and screening at the 20th IDFF Off Cinema Film Festival, Poznan and the Grand Off World Independent Film Awards, Warsaw.

Since returning to the UK early in 2020, Jordan's work has continued with further artworks focusing on what remains of our own mining heritage. Once the current Coronavirus restrictions are lifted, Jordan hopes to extend his exploration below ground and into hidden but not forgotten places.



A freight train passing the Kiveton Park Colliery, near Rotherham; this was painted from an archive photograph when Covid lockdown prevented Jordan from travelling in November 2020. The listed colliery buildings which date from the 1870s are an unusual survivor in the South Yorkshire Coalfield

Heavy electrical plant in the Elektrownia (power station) located in the closed Saturn Coal Mine in Czeladź, Poland

Jordan has kindly agreed to the publication of some his images in *Subterranea.* I hope you agree that they capture some of the essence of our rich and vibrant industrial past. More images and examples of Jordan's wider work and influences can be seen at https://easternbloc.wixsite.com/artist

Jordan Rodgers in front of some of his sketches at an exhibition of his work at Szyb Maciej, Zabrze in 2019

Corsham Telephone Exchange – Reversing the Changes

Martin Dixon

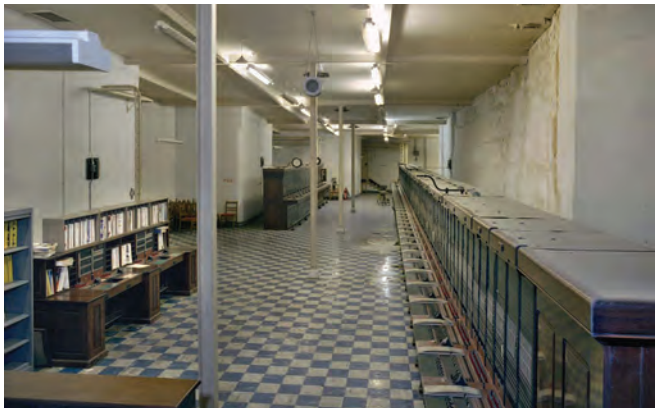
The Woodlands telephone exchange shortly after the Central Government Emergency War HQ was declassified in 2004. The 40-position GPO auto-manual trunk switchboard is seen on the left facing the international switchboard on the right. Some of the equipment was manufactured in the 1940s suggesting it was transferred from the earlier exchange complex in Area 1. Photo Nick Catford

In the early years of Subterranea Britannica, the Central Government Emergency War Headquarters beneath Corsham in Wiltshire was classified and strictly off-limits. Since it came off the secret list in December 2004 it has become well known to many readers, in which case feel free to skip forward a few paragraphs. For those who aren't as familiar with its fascinating history, read on!

Potted History

For many years during the Cold War, the government had top-secret plans to relocate Ministers and key civil servants should enemy attack render central London uninhabitable. The chief location chosen was Spring Quarry, a nineteenth-century underground Bath stone quarry.

Parts of the quarry complex had previously been used in World War II for ammunition storage and as an aircraft factory. Around 35 acres of this area was repurposed to provide accommodation for 4,000 and the facility was commissioned in 1955.



View from the balcony at one end of the exchange. The inland trunk switchboard is on the right with the international switchboard on the left. The directory enquiry desk is middle left with the supervisor's desk just visible in the foreground. At this time the ventilation system was still operating and although the exchange had stood unused for many years it remained in good condition. Photo Nick Catford

The site provided everything needed for both government and the residents to function – kitchens and dormitories, offices, GPO telephone switchboards and BBC studios and much more. Its existence was known only to a very few and no exercises were ever carried out to test its operation. Successive codenames for the complex (always capitalised) included STOCKWELL, SUBTERFUGE, TURNSTILE, CHANTICLEER and BURLINGTON.

Sub Brit has several connections to the site. In 2010, member Steve Fox wrote a comprehensive history of the complex, painstakingly researched from primary sources. This was issued as the only *Subterranea* magazine to date on a single topic – issue 22. Nick Catford's own terrific photographic record was itself published by Folly Books in 2012. We were lucky to have an official Sub Brit visit to Corsham in 2013 which was understandably many times over-subscribed and is written up in *Subterranea* issue 33.

The two-position directory enquiry desk. The grey shelving unit to the left of the desk contained a complete set of Yellow Pages for 1988, the last year for which updates were provided in the exchange. Photo Nick Catford

The international switchboard. Although outwardly smaller than the inland trunk switchboard opposite the internal arrangement of this unit is distinctively different in order to cope with the various switching and signalling protocols that its connection will encounter abroad. Photo Nick Catford

Scheduled Protection

Also in 2013, English Heritage (now Historic England) marked the national importance of the Corsham War Headquarters by designating seven separate areas as scheduled monuments (plus an area of the original 19th-century quarry and the Tunnel Quarry ammunition depot, making nine areas in all). Scheduling offers the highest level of site protection but does not of itself guarantee the ongoing maintenance of the heritage asset.

The seven areas of the War Headquarters that are now scheduled are:

- Prime Minister's Rooms and Operations Rooms
- Radio Station
- Lamson Terminus Room and associated Fan Room
- GPO Telephone Exchange
- Kitchen, Canteen, Laundry, Dining and Washroom areas
- Slope Shaft (Emergency Exit) A
- Personnel Lift (PL) 2

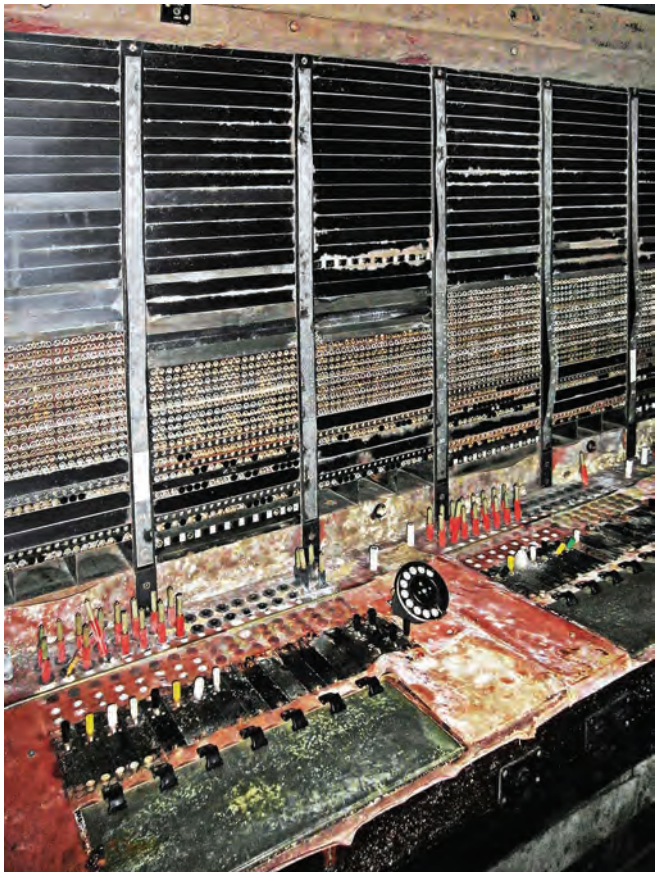
It's pleasing that both Steve and Nick's publications are cited in the scheduling reports, recognising the excellence of their work.

In about 2010 the air conditioning was switched off and decay very quickly set in as seen in a general view of the exchange during an official Sub Brit visit in 2013. Much of the equipment was covered with plastic sheeting to try and stop the rot. The directory-enquiry desk is on the left with the inland trunk switchboard to the right. Photo Richard Seabrook

Woodlands Exchange

The GPO (General Post Office) Telephone Exchange in the above list, also known as 'Woodlands', has a comprehensive array of mid-20th-century equipment. The principal rooms are manual switchboard rooms which have an astonishing 54 operator positions, finely constructed in mahogany. These are complemented by directory enquiries and supervisor's desks. In adjacent rooms are metal communication frames, a large MDF (Main Distribution Frame), workshops and an automatic telephone exchange.

Forty of the switchboard positions were for internal switching within the complex. The remaining fourteen would have communicated externally – with RSGs (Regional Seats of Government) across the UK and with Commonwealth and foreign governments, embassies and with organisations such as NATO.



Only three years after the air-conditioning was turned off water ingress and condensation left the exchange in very poor condition. Photo Richard Seabrook.

Support equipment includes air compressors, air handling plant, and a standby generator with associated switchgear that could run the entire exchange. There are ancillary items preserved too – loudspeakers and bells, light displays showing the exchange status, and store areas. The different areas of the exchange are neatly delineated with different coloured floor tiles. All in all, the exchange extends to almost 5,500 square metres, and is a remarkable survival. As often happens, traces of our heritage survive underground in a more complete state than above ground.

Heritage At Risk

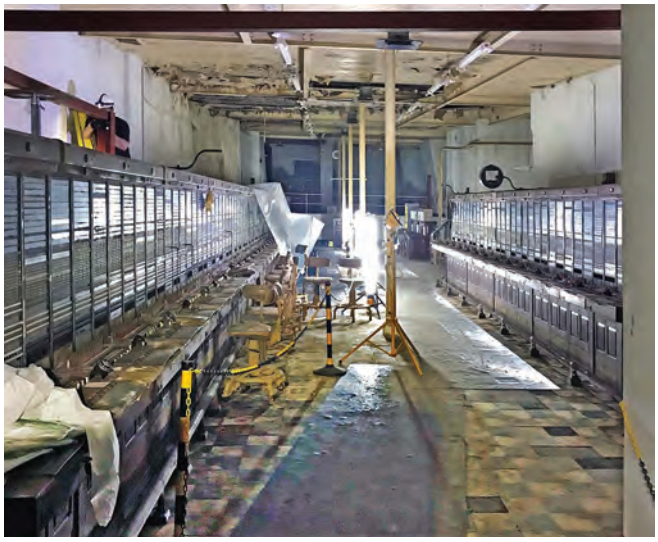
But underground environments can also pose hazards to preservation: after air-conditioning and other services were turned off around 2010, decay set in. Condensation and water ingress were affecting the exchange area, although the MoD Mines Management Team (MMT) did what they could by protecting the equipment with plastic sheeting.

By 2015, Historic England had placed the telephone exchange on the *Heritage at Risk* register with a classification of 'High Risk'. Later that year, funding was approved for local dehumidifiers and fans which arrested the deterioration while discussions continued. The risk status was downgraded to 'Vulnerable' and eventually the exchange was removed from the *At Risk* register.

The discussions between the MoD, Historic England and Wiltshire County Council led to the creation and signing

In January 2019 work was underway to build a protective steel structure around the exchange. This view from the balcony shows the exchange before work started. Photo Carl Smith

of a Heritage Protection Agreement (HPA). This has catalysed a further four stages of intervention to preserve the Woodlands Telephone Exchange. Firstly agreement was reached and MoD funding secured to protect the main switchboard room by installing steel framework and a false ceiling/roof that would isolate the environment from the rest of the complex. Mine Manager Peter Ralph secured the scheduled monument clearance certification.



Another view of the exchange in January 2019 with the 40-position trunk switchboard on the left and the international switchboard on the right. Photo Carl Smith

Protection and Preservation

Between January and April 2019 this protective structure was erected by a local company after a tendering process; the company selected was Corsham-based Racetec Fabrications. The new structure measures an impressive 30 metres long by 12 metres wide. It comprises a fabricated steel frame with an aluminium roof. We're grateful to Carl Smith of Racetec Fabrications for supplying some images of the installation work.

Stage two was to install dedicated dehumidifiers to maintain the environment within this new inner structure. Stage three involved installation of lighting to ensure the switchboards could be properly viewed.

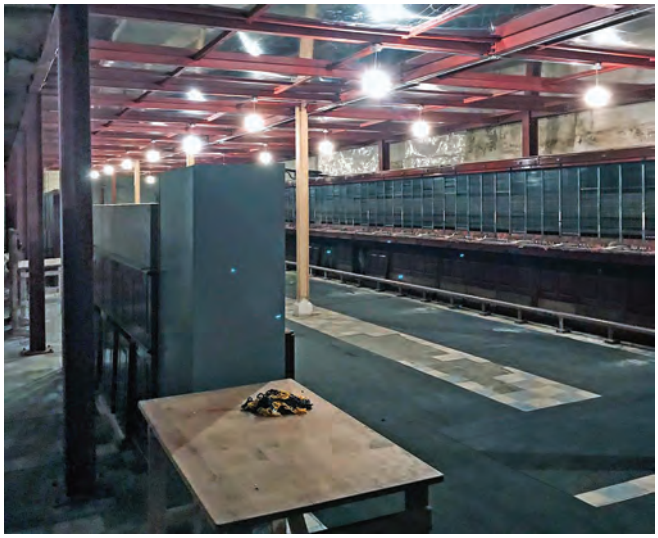
The fourth strand of intervention was to reverse the deterioration. Cold War specialist (and Sub Brit's first webmaster!) Mark Bennett led the project. Mark assembled a small team who started by removing the debris from previous roof falls. The operator positions were then painstakingly brushed and vacuum cleaned. Finally, conservation-grade wax was applied to the consoles.

After completion of the work the switchboards were almost 'good as new' and a stark contrast with the sad scene that has faced visitors for many years. And the good news doesn't end there; Mark is now undertaking a Conservation Strategy for the Heritage Partnership for the whole mine complex which can only lead to more of this unique and fascinating site being preserved for future generations.

Editor's Note: I have a series of photos taken after cleaning of the operator positions and applying wax to the consoles. The MOD refused permission for any of them to be reproduced in *Subterranea* even though they are already in the public domain!

References:

Subterranea issues 22 and 33 (available online or from publications@subbrit.org.uk)

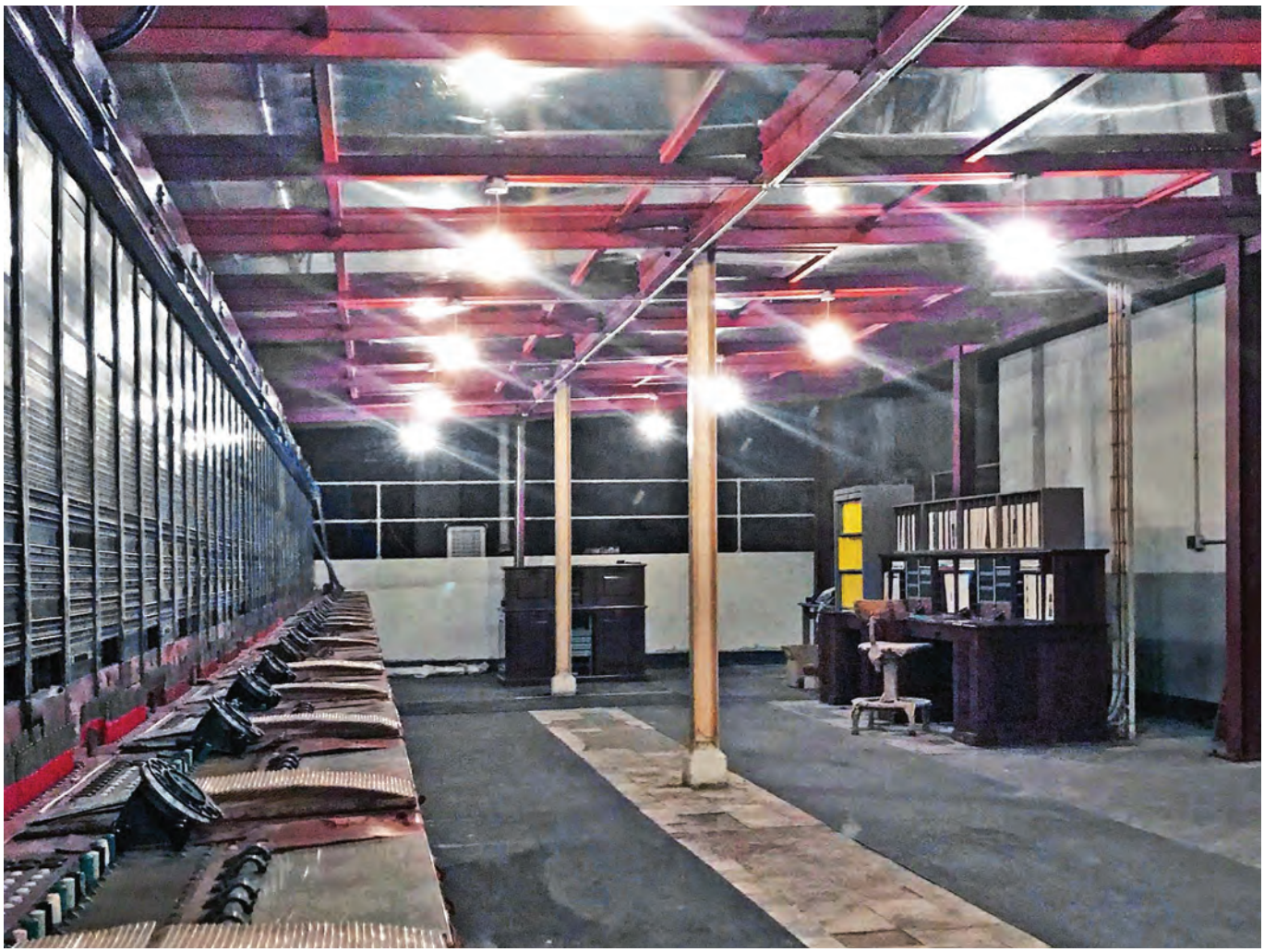


Looking east at the Woodlands Exchange in April 2019 after the completion of the fabricated steel frame and new lighting viewed from beneath the balcony and behind the directory enquiry desk. Photo Carl Smith

CATFORD, Nick, *Burlington,* Folly Books (2012), ISBN: 9780-9564-4056-3

Telephone Exchange Listing: https://historicengland.org.uk/listing/the-list/list-entry/1409129

Sanctuary (the MoD Sustainability Magazine), issues 48 and 49.



The east end of the Woodlands Exchange in April 2019 after the completion of the fabricated steel frame and new lighting. The inland trunk switchboard is on the left with the directory enquiry desk on the right. Photo Carl Smith

Buckden ROC Posts – Listed at Last

John Shere

The underground post and the adjacent Orlit at Buckden. Photo Nick Catford

Sub Brit member John Shere is a member of the ROCA National Heritage Team and an ex ROC member

After six years of work, the World War II Royal Observer Corps (ROC) Orlit 'Type B' aircraft reporting Post and the adjacent Cold War underground nuclear monitoring Post north of Buckden in Cambridgeshire are now Grade II listed buildings.

Diversion

The Orlit B is one of the finest in England and has an unspoilt view in a field close to the A1.

Both posts were under threat of demolition six years ago as plans for rerouting the A14 around Huntingdon showed that the new road was less than a mile from the posts. A larger risk came from the planned temporary construction compound to be built nearby; its actual location was not published.

After submitting a formal request in 2015, I was granted four minutes to speak at the Public Consultation meeting for the works held in Huntingdon. Before speaking I was contacted by a lady from ARUP – the official consulting

Despite being in poor condition the underground bunker is also listed. Photo Nick Catford

engineers. They had read my application and had gone to see the posts; they had no idea what they were. They also saw that I had made an initial Listing Application

with Historic England. Highways England contacted me afterwards and, to my relief, confirmed that they were now going to put the large construction site compound across the road from the posts.

I have to say that Highways England and ARUP were wonderful to work with. They set up a formal protection agreement between the Royal Observer Corps Association (ROCA) Heritage Team and themselves which put both posts inside a restricted circle area on their plans. This was called *A Statement of Common Need*; its purpose was to prevent any construction contractors going anywhere near them, even before they had started work. All later contacts were only with Highways England and they were always good to deal with.

I found that Historic England were unlikely to list the underground Post as they already had a few others listed. The listing application was therefore only made for the above ground Orlit. Sadly, this application was later turned down at a review in Cambridge.

The Orlit post. Photo Mark Russell

It became clear later that the farmer was likely to sell his land containing the posts for development. At this point contact was made with the Parish Councils of both Buckden and Brampton – the site being midway between the two settlements. Articles about the posts were put into the parish magazines and both councils gave their commitment to help save these historic relics.

If at first you don't succeed...

A new Listing Request was submitted in April 2019.This time much more detail was added, including highlighting the new risks to the posts. Historic England asked me to include the Cold War Post adjacent to the Orlit B and I am sure the support from the Chairs of both Parish Councils helped this second submission.

You may ask what happened between April 2019 and January 2021? A long saga which was not helped by Covid but work on the new A14 was completed many months ahead of time and the Orlit Post can now be seen from the top of the new dual-carriageway elevated road section. Before completion I asked Highways England if

The underground post in the foreground with the Orlit to the rear. Photo Nick Catford

I could be taken up to the new road section to photograph the Post. A young Kenyan civil engineer took me and was amazed when I explained what we were looking at.

Historic England produced a large amount of supporting detail about the story of ROC Posts and their contribution to the Cold War, for which I am very grateful. This was supporting to the application information. You might not know that the final formal granting of a Listing actually comes from the Government. They have been busy, but on 6 January 2021 the Secretary of State for Digital, Culture, Media and Sport (Oliver Dowden) decided to award the Grade II listings.

The land is now owned by a developer. No work has started yet and it could be a number of years before any housing development will start on the field containing the posts. Please do not go onto the land to visit it. The farmer has a dog you would not want to meet!

History Lesson

A bit of background history will help: the Orlit Posts were constructed in order to locate, identify and report low-flying enemy aircraft that could easily fly under our early postwar RAF radar systems. They were built by the Orlit Company in Buckinghamshire which specialised in prefabricated concrete buildings. They were delivered as kits of concrete panels and parts which were assembled on-site between 1952 and 1956.The 'A' versions were a box structure on the ground and the 'Type B' version was placed on legs with a concrete and steel access ladder.

The Buckden Orlit B had a short operational life. The new threat was of course intercontinental ballistic missiles. It was replaced by the construction of the underground monitoring Post which was constructed in 1968 and also closed in 1968. Sadly, this underground Post is not in a good condition internally as a result of vandalism in the past.

Hopefully this article also gives you an insight into the Listing process and the importance of gaining local support and of persistence and patience.

Icehouse Reflections: Thirty Years On

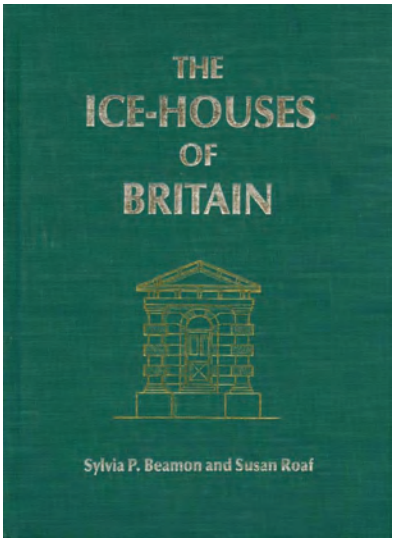
Sylvia Beamon

Inside the chamber of the Hatchford Park Icehouse in Ockham, Surrey in 1996. The domed ice chamber remains in good condition. Photo Nick Catford

Sylvia Beamon, who founded Sub Brit in 1974, is the co-author of the definitive book on icehouses across the UK, which was published in 1990. Here, she reflects on how her interest in icehouses first came about and on the long and arduous journey that led to the book's publication. It proves that with determination, anything is possible.

When Nick our Editor wrote and asked me if I would like to write an update on 'Icehouses', it seemed strange to return to the subject after such a long interval. On the other hand, perhaps it is an appropriate time as I look out of my window at the falling snow (early February 2019). It seems there is no hyphen in 'icehouse' now. I researched and studied this fascinating topic before the Internet and dictionaries started removing as many hyphens as possible between so many of our English words. The word *Icehouse* was one of the casualties – does it matter? Not really, provided that Google and Amazon will still find the definitive book on the subject.

This one: *The Icehouses of Britain,* BEAMON, S & ROAF, S. (1990).



But in the days before the Internet, it also meant foraging in encyclopaedias, researching and asking libraries, museums and individual historians for information. It also meant 'wellie boots' and a helmet in the haversack, trudging around stately homes (with permission), farms and dairies, and surveying structures that might or might not be Icehouses. It all started around the time I founded Sub Brit in 1974 and a week before I went to University to study Archaeology and Anthropology.

What is an Icehouse?

The catalyst for all my underground passion was the Royston Cave (near where I lived). One of my archaeological writing mentors Prof Raymond Mauny (Sorbonne, Paris) invited me to join what was to become our sister society, the *Société Française d'Etude des Souterrains* (SFES), and to give an illustrated communication on the Cave at their annual International Symposium in 1974.

Professor Raymond Mauny (second left) - the inspiration behind Sub Brit with other members of SFES in 1974. Photo Sylvia Beamon

My French is poor. It was arranged previously that I should read each paragraph in English and Prof Mauny would follow on in French. When we finished we were applauded! Then came the questions and the word *glacière* came up several times. The professor turned to me and said, "Could Royston Cave be an Icehouse?" I replied, "What is an Icehouse, I have never heard of one?" And so my curiosity was born.

At the following SFES Symposium in 1975 Prof Mauny and I repeated our duo act, this time on the topic of Icehouses. Unbelievably, the room erupted, some standing with cheering and clapping – I'd never had a response like this before! It was explained to me that no one else had ever considered Icehouses as a suitable underground subject for research.

I was elevated to the 'representative from Great Britain' (perhaps I should add that I was the only one), and introduced to the mayors and dignitaries wherever we went on our trips to go underground into *souterrains amenagés* – tunnels, dwellings, quarries and suchlike around local French villages in the Dordogne.

Without my realising it my Symposium communication was to stimulate several delegates to follow suit. Next year, both the French and Germans produced papers on Icehouses in their own countries. I also co-operated with researchers in the Netherlands and Belgium, two of whom produced books covering Icehouses in their own country.

Dissertation

In the University long vacation of 1975 I knew I really wanted to look into the subject of the preservation of ice. I wanted an original topic for my dissertation towards my Finals in the spring of 1977. Did early man have such knowledge?

The Icehouse in Holkham Park, Norfolk in July 2019. How an Icehouse works: The timber floor or grid, which covered the drainage sump of the ice well, was first covered with a bed of clean straw or reed. Ice or hard-tampered snow was then laid on the straw to a depth of about a foot. Successive layers of straw or reed and ice or snow followed, up to the level of the entrance door or passage. As the contents were used up, it must have been an unpopular task to go down by ladder into the bitterly cold well to hack out ice and bring it to the surface. A ring in the dome of this house suggests that some form of hoisting tackle was used in filling and emptying the well. Photo Sylvia Daintrey

Having studied the Palaeolithic hunters in the ice-age period in some depth and how they used the bones of mammoths in the construction of their dwellings in extreme temperatures, plus making comparisons with

the Inuits' (Eskimos') life styles who kept frozen caches of meat and baskets of berries outside their igloos, I was hooked. For all time humans need to learn how to preserve food at any time of the year, such as drying, salting, then why not freezing?

The dissertation decision was accidentally made for me by Prof C.M.B. McBurney, an archaeologist and excavation director in the 1960s and 70s. One morning he sought me out in the coffee room in the University Archaeology and Anthropology Department between lectures to inform me that he had found fragmented animal bones with cut and saw marks on them.

They were found in a pit within a natural cave at the La Cotte St Brelade site on Jersey that was considered once to have held selected joints of mammoth. He further felt this man-made pit could have stored such meat in the permafrost.

He had heard of my interest, and this particular excavation site was given an estimated Palaeolithic date of c. 140,000 years ago, possibly the earliest deliberate evidence of food storage anywhere. (BEAMON, S: 1977, *The Utilisation by man of Cold Elements, Frost, Snow & Ice* (unpublished Dissertation.)

First Experiment

Could I learn anything useful from an ad hoc simple experiment? How long would food last in a small 'snow stack'? Stacks themselves were known from literature on farms and a few stately homes but I had never heard or read of any containing food.

Battle Abbey icehouse in Sussex in October 2011. It was originally built by Godfrey Webster between 1810-1820. It sits atop a surviving medieval undercroft. Photo Sylvia Daintrey

The only experiment with ice I had ever noted was by Sir Francis Bacon, the 17th-century proto-scientist who died in 1626 following stuffing a chicken with snow and ice, thereby preparing the first recorded frozen chicken in British history. Perhaps chickens could harbour Salmonella even in that period of time?

Back in 1980, a weather forecast was promising; it was definitely going to snow within hours. Snow fell fast and quickly overnight; all roads out of Royston were blocked. Murray (my son) was unable to travel to work, but Sarah my student managed to drive parts and walk the rest pushing her motorbike to my house. It snowed again. A real opportunity – both Murray and Sarah were keen to help me.

I shut both the cat and dog in the house and decided what food I would try and freeze in an ice-stack. I went for a cooked lamb chop, a lidded jam jar containing whole pasteurised milk, two frozen fish fingers and two unfrozen fish fingers. I had already chosen the site of the proposed 'snow stack', a small circular grassed flat area, approximately a metre across at the end of the garden

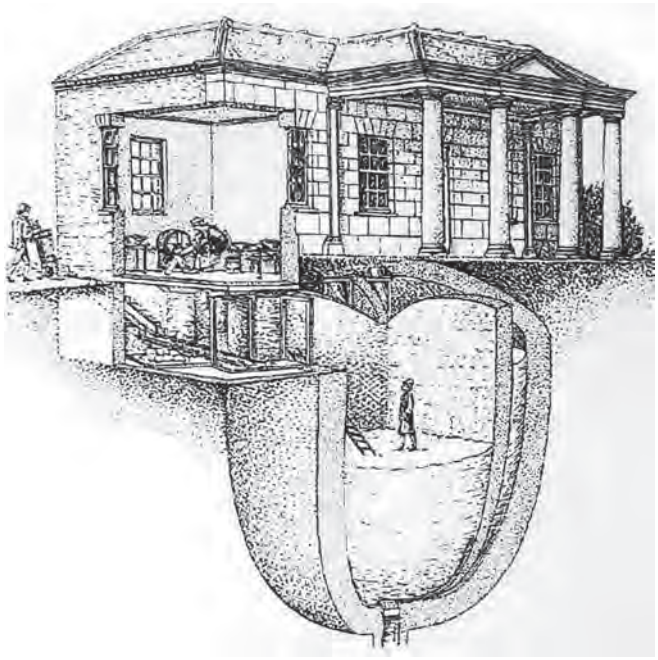
Murray wanted to make a large snowball so he started off, rolling and packing the snow around it as he went whilst Sarah and I, taking up a spade and bucket each, proceeded to pile snow on the ice-stack area, packing it as hard as possible into solid ice with the back of our spades until it was approximately a foot thick. I fetched first the chop, then the jam jar containing the milk. Both were set in the centre of the stack.

We packed handfuls of snow within the gaps between and around each item plus continued piling more and more snow overall and packing it as hard as possible, again forming another approximate foot-thick layer of ice. The two frozen fish fingers were brought out next, laid side by side in the centre, and handfuls of snow were pushed hard between them.

Petworth House Icehouse in April 2019. Petworth is an unusually large Icehouse and was built in 1784 on the site of an earlier Icehouse with a dairy above. The Icehouse was apparently used until the late 19th century, as an elderly estate worker who was alive in the 1940s could remember loading the chamber with ice. The dairy over the top of the Icehouse subsequently became disused and the space at the rear centre was altered to house a fire appliance. Photo Sylvia Daintry

Although the planned ice stack was only a relatively small area we needed an amazing amount of snow. Finally, we continued for at least another foot, again packing the snow hard. Finally I forced a stick from the side roughly into the centre of it then pushed inside the two unfrozen fishfingers and carefully sealed the entrance.

Nothing was placed over the top, although I had read that in the 18th and 19th centuries it was usual to pack straw on top with a tarpaulin above that. We tidied up and smoothed the sides down leaving no holes or gaps.



The Petworth Icehouse and dairy.

When we retired indoors I telephoned my mother, living a short distance away, asking her if she would take regular dated daily max/min thermometer readings. This experiment was carefully recorded but sadly the records got lost at the Iron Age experimental site in Hinchingbrooke Country Park (Huntingdonshire) some years later.

Findings

A few hours later our dog went into the garden and started to smell around the large snowball. It was not long before she began to claw away at the ice, force her way in until she found the two unfrozen fish fingers and ate them. Obviously in the wild, animals such as wolverines would have done likewise. She did not smell or touch the rest of the snow stack, so presumably no smell emanated from the frozen breaded fishfingers or the cooked lamb chop. The milk in the jam jar, of course, was sealed.

Every day my mother took the daily max/min temperatures. After eleven days temperatures began to rise towards midday and the top of the stack started to melt, with the water trickling down the sides and refreezing on its way. The temperatures again dropped below freezing overnight. We learnt that the air temperature could rise to 11 degrees Fahrenheit above freezing (6 degrees Celsius) but the stack stayed intact.

About five days later I saw birds sitting on top of the stack. When I inspected it I found both the remaining fishfingers were becoming exposed as the ice around them had continued to slowly melt. Birds were pecking and eating the breaded outside, but the fish was actually still frozen. Again in the wild, birds and animals would have done likewise. This explains why it was necessary to cover ice stacks with tarpaulins or thatch.

York icehouse in April 2018. The York Icehouse which is partly sunk into the city wall rampart to the rear of the Bay Horse pub in Monkgate probably dates from the late 18th century. Photo Hector Sparrow

York icehouse being restored in 1977

The cat's whiskers

Next, as the stack continued to slowly melt, the jam jar became visible. I removed it, opened it; the fats had separated in the milk, it smelt alright, it tasted alright, so I drank it. If early man had placed milk or cheeses within covered pots there was no reason why such food would not have become frozen and preserved for three weeks or more.

The cooked lamb chop lay a few inches below. The following day it was just about uncovered so I took it out. It smelt alright, I nibbled a small piece and it tasted fine. I gave the rest to the cat who thought Christmas had come and ate it all! Cats are notoriously fussy so I knew there was nothing wrong with it. Success. The stack had survived overall for three weeks.

Experiments at Butser

Over the coming years, two further experiments – this time in underground ice pits – were undertaken and prepared at the Butser Iron-Age Experimental Centre in Hampshire. Firstly a small pit cut in chalk on site was allocated, where there would be no problem with drainage.

Dr Peter Reynolds used thermistors to record temperatures between layers of barley straw (as used in the Iron Age) and packed natural snow. No food was stored on this occasion, but the stored ice lasted for six weeks before melting.

Let it snow

Building on these results, a larger pit on the Butser site was cut, but not in chalk this time. A problem arose in that a ditch had been cut into one side of the pit which was part back-filled with different materials. This would potentially create temperature differences and drainage issues as icehouse pits are normally dry, smooth-sided, preferably tapered and with a drain at the bottom.

Given the quantity required, I'd selected flaked ice as used by trawlers for icing fish at sea. I had turned down man-made ice-balls with a space in the centre manufactured for pubs as these could not have been made and used in the Iron Age.

18th-century Icehouse in woods on the Felbrigg estate in Norfolk. Photo Sally Carr

On the day of the experiment, disaster: the lorry was really late. As we worked with the lorry crew to lift out trays of the flaked ice, water was running out and away. It was all wet and sloppy, not relatively dry. Water was also steadily running from the lorry; obviously, the ice shrinkage and rapid melting was happening so quickly.

Although there had not been any snow for a couple of years, the sky grew dark, the clouds deepened and as the men were actually emptying the ice into the pit, ironically the heavens opened and we had a short sharp snowstorm. Unfortunately, it didn't last long. There was not enough ice in the pit to layer it with straw, so the straw was placed on top in the hope something could be salvaged from the situation.

The British Icehouse book

Some years previously, I had started a card index on the various icehouses around Britain and wondered if there were enough of them to warrant a book. When I saw an advert in Hertfordshire where an estate agent was selling a property with an extant icehouse, claiming to be only one of seven known in the country, I knew this was wrong because I had located 72 already.

In 1980, Susan Ross, an architect, and I met in London. I asked her whether she would consider writing a book with me, Susan's architectural interest being in the gathering and storage of ice in the Middle East which I thought could complement my own study.

Icehouse at Hatchford Park, Ockham, Surrey in 1996. Having been converted into luxury flats in the late 1990s, Hatchford House was destroyed by fire in 2000. It is unlikely that the fire affected the Icehouse however it is located close to the house and its present condition is unknown. Photo Nick Catford

The short entrance tunnel leading into the domed ice chamber at Hatchford Park in 1996. Photo Nick Catford

Susan was keen to link up with me and coined the expression 'The Great Icehouse Hunt' to commence our joint effort to find how many structures there might be in the UK. Susan volunteered her mother Shirley to start contacting people by sending out a survey sheet (designed by us both), for each known example.

I was to concentrate on finding a publisher. Six weeks later Susan decided to leave Britain and follow her fiancé Michael Roaf (an archaeologist) to Iraq, whilst her mother would continue to work with me. Initially, Susan said she would help me from Iraq but working at this distance (pre-Internet) proved unsatisfactory.

Shirley and her husband then decided to sell up and return to their native Australia. So, within six months, I was left high and dry, in what was to become an enormous project. I improved and finalised the first draft Survey Sheet and resigned from my paid job with Cambridge Preservation Society and just carried on regardless. My correspondence was soaring, hundreds of icehouses were being found all over Britain.

Sub Brit to the rescue

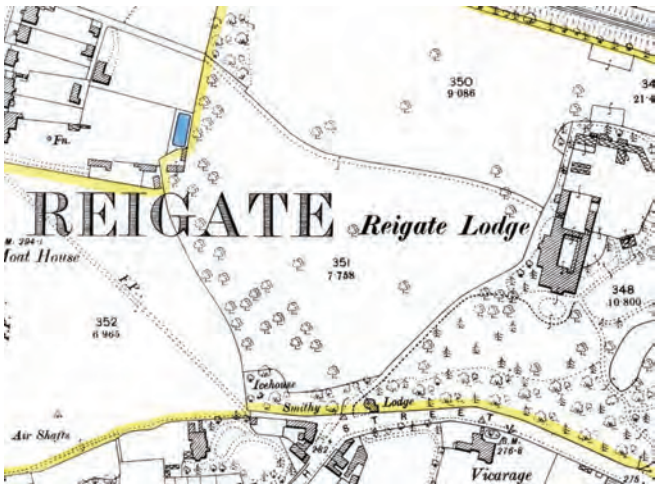
Thank goodness for Subterranea Britannica. By now (1981) I was desperate and I approached the Sub Brit Committee for help. They agreed I could call for volunteers and unexpectedly, I was then overwhelmed with offers. Members who came forward included land surveyors, geologists, historians, scientists, builders, architects, professional photographers, engineers and more.

Up and down the UK I gathered many more new colleagues, from County Planning Officers, several Local History society members, even University map staff. Many were eventually to become long-term friends. Most counties became covered, both for survey and photographic work. Whoever helped me knew their work would be acknowledged and as I organised every entry received, the book grew and grew.

Grants from the British Academy and the National Monuments Record came through. I approached eighteen publishers before I found Routledge Kegan & Paul. The owner, Norman Franklin, who had an icehouse on his own property, showed real interest in the subject and told me to keep going and try and find ALL of the remaining icehouses in Britain.

The short entrance passage leading into the domed ice chamber at Reigate Lodge, Surrey in May 1996. Photo Nick Catford

The ice chamber at Reigate Lodge is filled with soil almost to the level of the entrance tunnel. Photo Nick Catford



Many icehouses are shown on large scale Ordnance Survey maps. This is Reigate Lodge in 1896

Nobody could have anticipated that I was to locate nigh on 3,000 records with so many still actually surviving intact. As the years passed by I was now calling the book, 'my book'.

Setbacks

Many problems were to occur over the coming years. Norman Franklin, the publisher's owner, died. The publisher was bought out by a series of four different companies causing delays over ten years.

One company lost all the disks (17 of them which I replaced), another lost all the original Welsh icehouse plans. I replaced them as fortunately I had kept duplicates but other slides of experimental work in Cumbria were never seen again. It was very disappointing and frustrating because the one and only record of this type of experiment in modern times was now null and void.

Published at last

Susan and her (now) husband returned to Oxford nine months before the final publication date in 1990. Susan had completed her PhD. Besides working in the Middle East for some time they had also travelled to Australia and the USA. Susan asked to come back in to help with the book.

Although I had already started writing up the front section it made sense for Susan to continue with this as it would reduce my work load. Susan and I sorted out the photographs and plans together. Susan collected Section I material, took it home and continued to write up all the remaining information. She asked to have her name placed first on the book cover and inside, instead of mine. I refused.

As I said above, from the time of Susan's emigration, I had tended to call it 'my book' but luckily Beamon precedes Roaf alphabetically and the academic convention is to list authors alphabetically.

More setbacks

The final publisher – an American one – caused me the most anguish; they decided they did not want the book at all and tried to cancel the contract. I took advice, and with aid from a legal representative from Cambridge University Press, the original contract agreed with

Reconstructed icehouse at Sierra de Espuna, Spain in 2013. Photo Lee Collis

Norman Franklin was upheld. But there were still difficulties, for example initially they refused the Index. I insisted it was really necessary. Eventually they agreed but at the last minute I had to cross-reference all Gazetteer entries to Part I. The expected print run was cut from 3,000 to 750. The publisher did little to advertise the book and sent out very few copies for review. Its cost, set by them, was prohibitive at £100 per copy (1990), and was raised to £120 a couple of years later before being remaindered shortly afterwards.

One disadvantage of a single volume is that as more icehouses turn up (which they still do), it isn't possible to update the gazetteer with their details. Similarly new material on building records and the industry of ice has to exist as separate records for the present.

Postscript

Today, Hertfordshire County Council Library holds three copies as reference copies at County Hall in Hertford. I gave a signed copy of the book around 2004 to Royston Library for my own townspeople.

Comparatively recently it has been removed from Royston and placed in Hertford again, as yet another reference copy. Although I protested, they informed me that they consider this book is too important to be allowed on open shelves. Perhaps I should feel gratified.

References

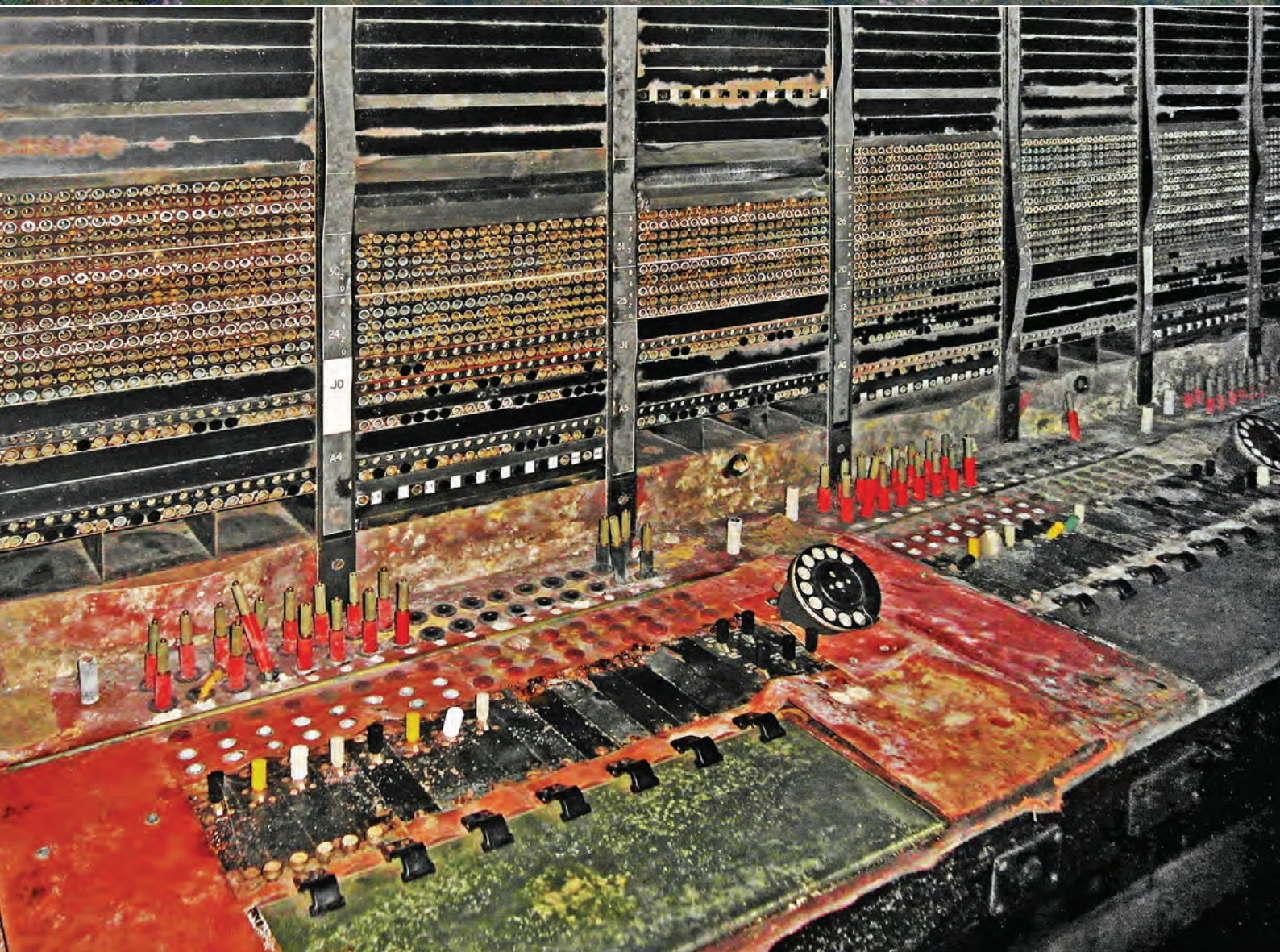
The Icehouses of Britain, Beamon S. & Roaf, S. (1990).

Les Glacières à glace naturelle de Wallonie, Belgium, Leo Robberts (1989) Fondation Roi Baudouin.

Eiskeller: Kulturgeschichte Alter Kühltechniken, Wessel Reinink and J. G. Vermeulen (1995) Kulturstudien Sonderbände.

V2 Rocket launch site in France

The Coupole d'Helfaut-Wizernes originally codenamed Bauvorhaben 21 (Building Project 21) or Schotterwerk Nordwest (Northwest Gravel Works), is a Second World War bunker complex in the Pas-de-Calais region of northern France, about 3.1 miles from Saint-Omer. It was built by the forces of Nazi Germany between 1943 and 1944 to serve as a launch base for V-2 rockets directed against London and southern England, and is the earliest known precursor to modern underground missile silos still in existence. This oblique of the Wizernes V2 rocket installation was taken on 10 July 1944, before the attack which caused the subsidence of the quarry face.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